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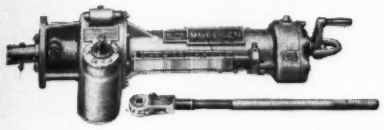

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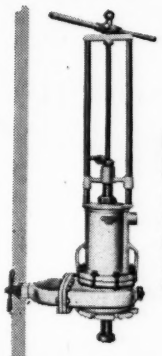

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GAS

29th Year of Publication

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George McClure of Battelle (left) demonstrates electronic equipment to be used in pipe fracture tests at Athens to C. F. deMey. For complete story, see page 87.

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Thermally Thinking

SPOT NEWS AND COMMENT ON GAS INDUSTRY AFFAIRS

Highlighting the News

Gains shown in Canadian natural gas use

Despite stuttering governmental development policies, Canada's sales of natural gas are inching upward. A seventh-month report shows 1953 ahead of 1952, 44.5 billion cu ft against 41.9. Manufactured gas sales show the usual accompanying slide, totaling 15.9 billion against 16.2 for 1952. In July, sales of natural hit 3.2 billion, as against an almost even 3 billion for the year previous.

Gathering tax faces test

The Texas tax on pipeline companies will be scrutinized by the U. S. Supreme Court in January, which has agreed to review the state court's decision upholding the law. Texas' Governor Shivers says he welcomes the test and is confident that the disputed law will be found constitutional. Other crucial natural gas tests will also be made in the session, as reported in "An Eye on the Capitol" column.

Gas in 3-D

A 12-minute color film, "This Is Your Line," is now available for 3-D showing. The movie covers 1953 construction on four major pipeline projects. H. C. Price Co., the producer, is offering the movie for public showings. Scenes include shots of construction on Tennessee Gas, Texas Gas, Southern Natural, and Gulf Interstate jobs. Special projector, screen, and polaroid glasses are required for viewing.

Furnace shipments climbing

Central heating equipment showed moderate-to-good gains in September, GAMA reports. Furnaces were up 11.2% over September 1952, a sharp recovery from August's decrease of 4.7%. Aggregate third-quarter gain was 8.5%; for three quarters, the increase was 19.2%. Total shipments for nine months, 374,400 against 314,100. Boiler shipments were up, too—19.8% for the month, 12.5% for the nine months. Conversion burners recorded a tiny 2.4% gain, and for the nine months they were only 1.8% ahead of 1952.

Other appliances make minor recoveries

From August's poor showing, range shipments in September crawled up to 201,400, 0.9% ahead of 1952. For the nine months, 1953 was still running 5.7% ahead with total shipments of 1,660,600. Gas-to-electric ratio through August was about 1.5 to 1. Water heaters scored a 3.7% gain in September, hitting 177,500. Year-to-date was ahead by 10.9%, with an aggregate of 1,649,500 shipped.

PGW throws weight behind incinerator sales drive

Sales-minded Philadelphia Gas Works Co. is sparking a gas-fired incinerator promotional campaign, to start in January. The utility, which has been neck-deep in "matchless" range campaigns for some time, plans to bring together manufacturers and dealers in a giant sales program. TV will be included in a generous advertising budget.

New York stalks defective gas refrigerators

In late September, the first death from water-cooled gas refrigerators in two years touched off another intensive drive by city inspectors to clean up the menace. By mid-October, 200 health department agents had found 2400 defective units, of which they sealed 999. All told, there are estimated to be 40,000 still in use despite the previous drive.

An Eye on the Capital

Suggestions from INGAA

The Independent Natural Gas Assn. of America, with headquarters here, is busily engaged in preparing to submit a series of suggestions to the Federal Power Commission, at the invitation of Chairman Jerome Kuykendall, regarding changes in rules, including those affecting certificate applications and rate filings, with the objective of facilitating both the work of the FPC and of the companies it regulates.

Just what the suggestions will be remains to be seen, for INGAA understandby is wary about letting its ideas leak out before these are submitted to the most exhaustive analysis and made available to the FPC itself. The INGAA feels that it could be accused of "pressuring" the commission to adopt its idea if it made public its views in advance, while the idea of the officials basically is to cooperate fully with the FPC.

C. P. Rather, president of the INGAA, speaking to the association's annual meeting recently, said the INGAA was most grateful for the invitation to meet with the FPC to discuss means by which the commission might facilitate its procedures and to consider problems of concern to the industry. He made public the FPC's

Thermally Thinking

invitation to offer practical suggestions.

"We propose to submit such suggestions," he told the INGAA. "In preparing our suggestions, it will be the objective of the association to do exactly what we were invited to do. That is, to suggest revised procedures which will facilitate the work of the commission and the business of the companies without in any way conflicting with the provisions of the Natural Gas Act. We appreciate the fact that our suggestions will be subject to careful scrutiny and intend that they will be of a caliber sufficient to stand such scrutiny."

Who regulates whom?

INGAA is not the only principal in the case that wants to proceed cautiously to avoid any charges of "pressuring." Chairman Kuykendall believes an error in September *GAS* might lay the commission open to such a charge, and has requested that the following letter be printed:

> On page 27 of the September 1953 issue of your magazine under the heading, "FPC flopover," your magazine states that the Federal Power Commission invited leaders of the gas industry to meet with them on Sept. 16 to discuss the possibilities of an industry advisory group to study the various regulatory problems confronting the commission and the industry.
>
> It is true that the commission met with representatives of the natural gas industry on Sept. 16, but it is not true that the meeting was held to discuss the feasibility of a gas industry advisory group.
>
> The meeting was called for the purpose of investigating ways of increasing the efficiency of the operations of the Federal Power Commission. The commission intends to invite other groups to similar meetings for the same purpose. At the Sept. 16 meeting it was not even suggested by anyone that any kind of permanent advisory group be formed and none is or has been contemplated.
>
> This article may cause some readers thereof to suspect that the natural gas industry is regulating the Federal Power Commission, instead of the commission regulating the industry, as is its duty. Therefore, in fairness both to the natural gas industry and the Federal Power Commission, I request that you print this letter in the next issue of *GAS*.
>
> I might add that I believe that any regulated industry and the members thereof have a perfect right to make their views known to a regulatory commission, but I do not believe that any standing industry advisory committee to a regulatory commission is necessary or proper.
>
> *Jerome K. Kuykendall*
> *Chairman, FPC*

By welcoming the new commissioners with somewhat more enthusiasm than two certain ex-chairmen were ever accorded, *GAS* may have unwittingly helped to give the "liberals" ammunition. Let there be no mistake about it: the only course the industry can, and should, hope for is one that's smack dab down the middle. Regulation will continue to issue from the commission, not from the industry. No one has a desire to make a mockery of the Natural Gas Act.

Cooperation with NARUC

FPC's new chief is certainly not afraid to talk on a variety of matters. In recent speeches before various groups, all intimately connected with the natural gas industry, he has spoken in a forthright manner on natural gas topics.

Before the 65th annual convention of the National Assn. of Railroad and Utilities Commissioners recently in New York, he stressed the willingness of FPC under the new Eisenhower majority to cooperate with state commissions.

"The members of the FPC have worked seriously and diligently with you in an effort to find the best way to define the state and federal responsibility in the regulation of natural gas companies," he pointed out.

Referring to the commission's position on the Hinshaw Bill (H.R. 5976), which relieved purely intrastate gas distributors from FPC jurisdiction, he stated:

"Although all members of our commission did not approve the particular language of this bill, nevertheless we are in complete agreement on the general principle that, insofar as our system of dual government permits, regulatory matters of a local nature should be handled by local regulatory authorities."

Mr. Kuykendall's views on the Hinshaw bill are also reported in his address before the INGAA in Houston (see page 106), and essentially the same remarks were embodied in his address before the National Institute of Municipal Law Officers, at its Washington meeting. On this latter occasion, he had to face up to some sharp questioning from the local legal eagles.

Administration is wary

While the Hinshaw bill seems to have more or less clear sailing (although some "liberal" opposition undoubtedly will develop), there is increasing gas industry concern here over the lack of progress in proposed amendments to the Natural Gas Act.

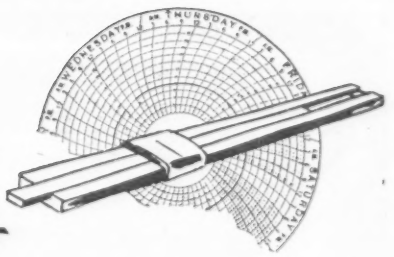
On the more far-reaching proposal to relieve FPC from jurisdiction over independent gas producers, there is a disposition to do nothing at the next session. There is a growing belief, based on statements by administration leaders, that the administration is going to take a "liberal" tack in the coming months in order to win the next Congressional elections, although there is no reason to think that the widespread farmer dissatisfaction with the administration is due to what few moves it has made in the direction of restoring solvency and saneness to government and administration. But, whatever, the President seems to be lending an ear to the more "liberal" groups, including those of his associates who flirt with the "liberals."

The two reasons given for the go-slow attitude are (1) political caution in an election year in view of the "pro-consumer" agitation; and (2) pending review of the Phillips Petroleum Co. case by the U. S. Supreme Court. The "liberal" columnists have been hammering away at the "natural gas giveaway," and are likely to become more active if the legislation to free independents of regulation is introduced. Furthermore, several "liberal" senators have threatened a filibuster in the Senate if the bill should get to the floor.

Conferences on natural resource problems are scheduled to be held in Washington Dec. 2-4, sponsored by the Ford Foundation, which has formed the

Continued on page 62

Technical Trends



• By GUY CORFIELD

Polyethylene possibilities

One of the most intriguing of the plastics, from almost every standpoint, is polyethylene, and it would seem that there must and will be numerous uses for it in the gas industry. It is perhaps best known for its use as semi-flexible "squeeze bottles" and for numerous household kitchen articles such as refrigerator food containers and sink strainers. The present production capacity is about 150 million lb per year, which will probably be doubled by 1954 and increased to 500 million lb by 1956.

Polyethylene is chemically inert, a good electrical resistor, has no odor or taste and is of low toxicity; with a specific gravity of 0.92 it is the lightest of all solid plastics; it remains flexible over a wide range of temperature without plasticizing, being shatterproof at —40° F and unaffected by boiling water—in fact, it is practically unbreakable; from a decorative or identification standpoint, it can be produced in a great variety of non-deteriorating colors.

Beyond the multitude of household uses, it has a potentially infinite number of technical and industrial applications. Chemically, it can be used for unbreakable and non-corrosive containers, and has been made in shapes as large as tubs ½ in. thick and 105 in. in diameter. An increasing application is for battery cases, to replace the conventional hard rubber. An interesting development is its use for water meter impellers, in which service it is flexible enough to let small solid particles through without damage to the meter or obstruction of flow. It has been applied as safety shields for pipe flanges and valve bonnets in chemical plants, being easy to install, and revealing of leakage without removal because of semi-transparency. Another typical use is for tool boxes, to prevent damage of sharp points and edges and to suppress rattles. It is also formed into flexible pipe which has a variety of uses. It can be compression- or injection-molded, or extruded, and it has been reported that some progress has been made in solution casting and flame spraying.

Polyethylene is, obviously, potentially attractive to the gas industry as a material for underground gas piping or as a coating for metal pipe. Used by itself for this purpose, it will require modification to greater rigidity and resistance to distortion, and as a coating for metal tubing it will be necessary to develop techniques for bonded application; and, with either use, there will be the problems of making lateral connections, applying coating patches etc.

Heat-capacity standards

Heretofore, water, because of its ready availability in high purity, has been used as a standard for heat-capacity measurements in calorimetry work and on it is based the familiar British Thermal Unit (Btu), the amount of heat required to raise one pound of water 1° F; however, its use is practically limited to the temperature range between 0° and 100° C, and there has been an increasing need for other heat-capacity standards to extend this range and make possible the calibration of various types of calorimetric equipment operating under other temperatures and conditions than those employing water for the primary measurement.

Benzoic acid, n-heptane, diphenyl ether, and aluminum oxide have been suggested as suitable substances and the Bureau of Standards has prepared them in pure state, calibrated them and has them available for limited distribution. Benzoic acid can be used as a solid between —259° and 80° C; n-heptane is a solid from about —259° to —90.6° C and a liquid to about 130° C and does not expand upon freezing as does water; diphenyl ether is solid from about —259° to about 20° C and a liquid up to 300° C and is chemically inert; aluminum oxide (synthetic sapphire or corundum) is a solid through all temperatures, is now standardized from —259° to 900° C and when accurate measurements of its heat-capacity are made at higher temperatures, can be used up to 2000° C.

Heat technology

Anyone wishing to add to his library or reference file on heat technology would do well to obtain a copy of the *Chemical Engineering* issue of June 1953. This issue contains, on pages 175 to 238, under the above title, a "report on current theory and practice" including sections headed as follows:

The Thermal Spectrum in Heat Technology
Fuels—Choice and Handling
Combustion Theory and Practice
Electric Heating Methods
Refrigeration and Refrigerants
Tubular Process Furnaces
Metals for Extreme Temperatures
Refractories for Every Use
Insulation for Heat and Cold
Media for Heat Transport
Advances in Heat Transfer
Trends in Heat Exchangers

The "Thermal Spectrum" is an 8-page colored folding chart showing Methods of Heat and Cold Production; Melting Points of Metals and Oxides; Practical Working Temperatures of Insulators, Refractories and Metals; Operating Range of Heat Transport Media; and Operating Range of Typical Processes. These data are presented in a tabular-graphical manner, covering the range from —400° to 5500° F.

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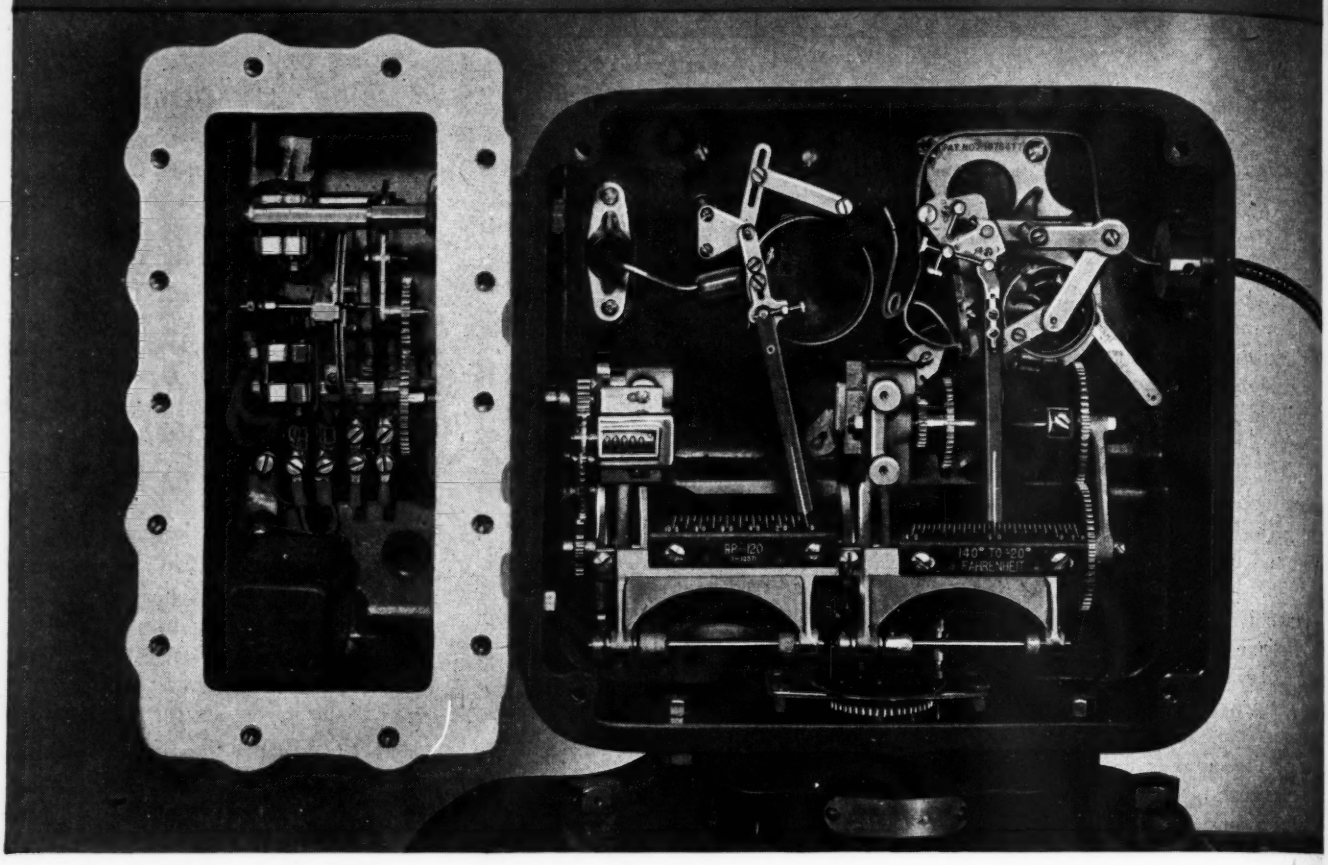

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GAS exclusive

TPC — a thermal cracking process for producing high-Btu gases

By **T. F. LOUGHRY** • Surface Combustion Corp., Toledo, Ohio

At the end of World War II an urgent need existed in the manufactured gas industry for a process with a low investment cost that could produce a fuel gas substitutable for manufactured gas in large quantities to satisfy the requirements of a few high peak days during the heating season. This situation led to the installation of a number of catalytic cracking plants for production of equivalent city gas by cracking L. P. gases.

At an early stage in the development of the catalytic process it became evident that the use of feedstocks heavier than L. P. gas had several advantages, of which the most important was ease of storage at a low investment cost. The catalytic process was expanded to permit the use of gasoline in the boiling range of heavy naphtha as a feedstock.

During the period of the development of the catalytic process, a great deal of interest was shown by the industry in processes utilizing oil, climaxed by the development of the Hall gas process, which was rapidly adopted by a number of companies in New England. A definite trend developed in the manufactured gas industry toward higher heating value gases, accelerated by the construction of pipeline facilities for bringing natural gas to the eastern seaboard. It became apparent that, within a few years, a need would exist for a process which would accomplish in the high-Btu field what catalytic cracking had done in the normal 500 to 550 Btu bracket.

An investigation of existing processes indicated that none of them could meet the requirements of an ideal oil-gas process, which should include the following:

1. It should be able to manufacture a true oil gas in the heating value range of 950 to 1050 Btu with a specific gravity between 0.55 and 0.65.

2. The process should be continuous rather than cyclic to permit the accurate control of temperature and cracking conditions necessary to produce a gas of constant quality. The continuous process also lends itself to automatic control through proper instrumentation.

3. It should be able to utilize a wide variety of feedstocks including heavy residuals chosen on price and availability with no limitation on carbon content.

4. Its operation should be governed strictly by the type of gas to be made with no limitations being imposed by the characteristics of the heavy tars produced.

5. The liquid products should be sufficiently fluid to permit ease of handling and should be recoverable in a manner which would eliminate formation of emulsions.

6. The heat requirements of the process and the amount of carbon laid down should be independent of each other so that no limitation is imposed upon the choice of feedstock by its carbon content. Excess carbon should be recoverable as a by-product.

7. Waste water and effluent disposal should be held to a minimum by the elimination of water as a washing or direct scrubbing agent.

A process intended to fulfill these requirements is Thermofor Pyrolytic Cracking, described on the following pages.

Fig. 1. Exterior view of the TPC pilot plant, with oil storage in foreground. Only a small portion of the building shown is used for the control instrumentation and auxiliaries of the pilot plant.

HOW THE PLANT OPERATES

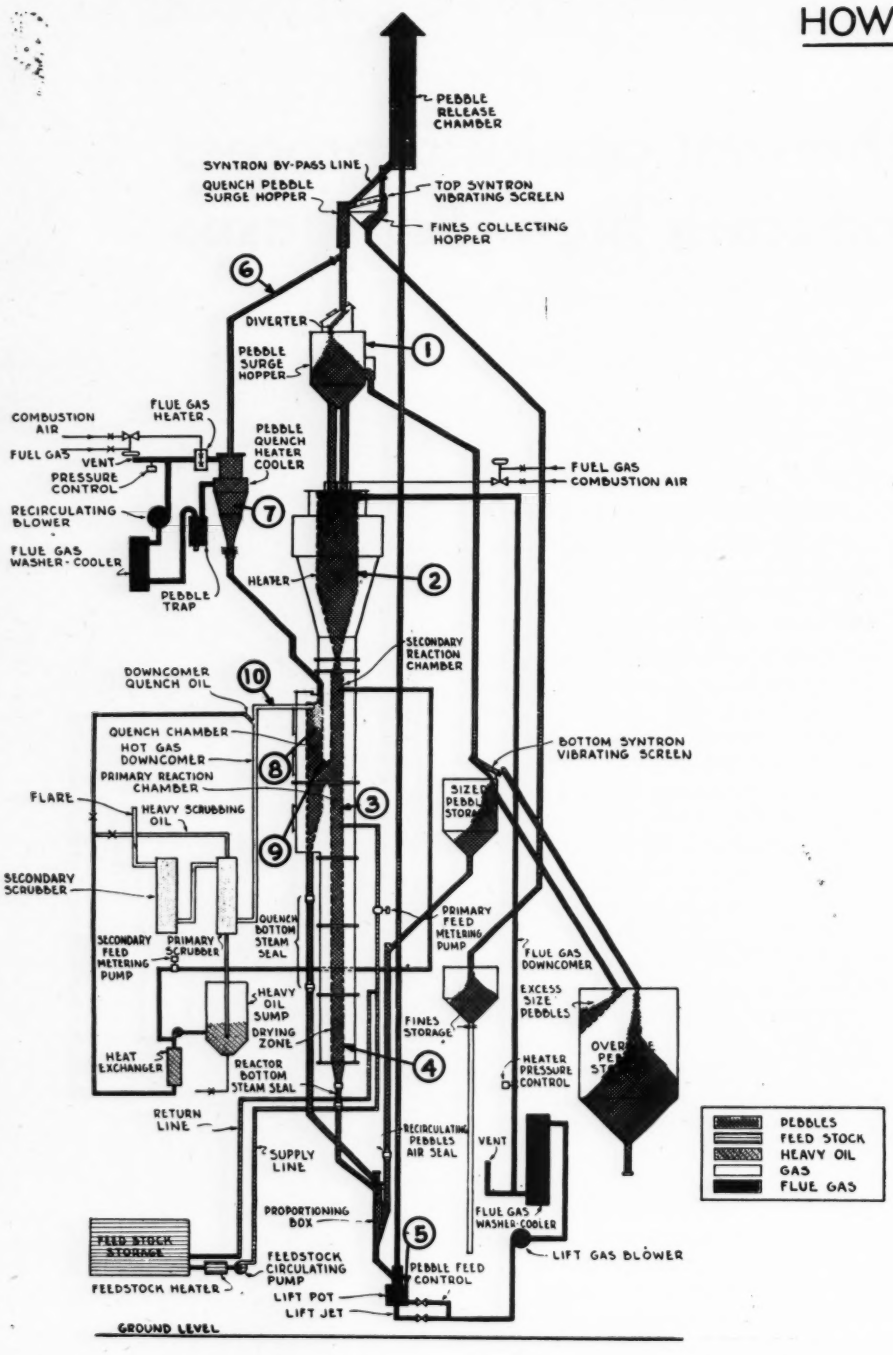


Fig. 2. The TPC process consists essentially of two major streams of solid particles consisting of dense, hard petroleum coke pebbles ranging in size from ¼ in. to ¾ in. in diameter. The main stream of pebbles enters the unit through the surge hopper (**1**) and flows downward to the heater (**2**) where it is heated to a cracking temperature of 1500° to 1600° F. The heated pebbles flow through a neck at the bottom of the heater into the reaction chamber and are contacted with raw feedstock at point (**3**). Vaporization and initial cracking begin at this point. The residual carbon and some uncracked oil deposit on the pebbles which continue to flow downward through the drying zone (**4**) where final coking takes place. The pebbles emerge from the unit through a neck at the bottom, flowing into the lift pot from which they are elevated by a continuous stream of flue gas to the top of the unit where the cycle is repeated.

A secondary stream of the coldest pebbles in the system is diverted through the line (**6**) at the top of the unit and flow through a heat exchanger (**7**) where provisions are available for controlling their temperature at a level lower than the cracking temperature. These pebbles flow downward and enter the quench chamber (**8**). The hot gases and vapors which have been released in the cracking chamber enter the quench chamber at the crossover connection (**9**) where they are quenched very rapidly to the temperature of the quench pebbles. The quenched vapors pass upward through the quench chamber and are removed from the unit through the product line (**10**). The quench pebbles proceed downward through the unit, join the stream from the reaction chamber, and enter the lift pot where they are raised to the top of the unit simultaneously with the pebbles from the reaction chamber.

Mr. Loughry, a Carnegie Tech mechanical engineering graduate, was with Doherty Cadet Engineers and Combustion Utilities Research Institute before joining Surface Combustion Corp. in 1934. Since its formation in 1948, Mr. Loughry has headed the company's Gas Products Div., which has constructed a number of catalytic cracking plants for peak load shaving and natural gas reforming.

Thermofor pyrolytic cracking (TPC) is a process of recent origin that is being watched by gas production men for its applications in producing high-Btu standby oil gas. The subject as presented by the author in a different version at the last AGA production and chemical conference stirred up a great deal of interest and some controversy, and has since been subjected to active study by plant engineers in the AGA.

The process, an adaptation of Thermofor catalytic cracking as used in oil refining, is unusual in the manner in which heat is transferred from one portion of the tower to another, as well as in the application of a circulating stream of petroleum coke and the formation of free carbon.

A SEARCH for a process which would most closely approach the fulfillment of the seven requirements (see page 27) led to the investigation of the experimental work which had been conducted by a number of oil companies and culminated in the signing of an agreement between Socony Vacuum Oil Co. and Surface Combustion Corp. covering an arrangement for the introduction of the Thermofor pyrolytic cracking (TPC) process to the gas industry.

The various elements of the TPC process had been investigated by Socony Vacuum in its laboratory and a large

amount of experimental data had been collected. Many of the elements of the process, however, had never been tested in conjunction with each other and it was felt necessary to proceed from the laboratory stage to the construction and operation of a pilot plant.

Construction of the pilot plant was started in March 1951 and operation began in January 1952. For the succeeding 15 months the plant has been operated intermittently, the operating periods being interspersed with periods of shutdown to provide for test changes and new construction. This unit *(Fig. 1)* has a designed capacity for processing 70 bbl of oil per 24-hour day and the production of 240 Mcf per day of 1000-Btu gas. The pilot plant is 137 ft high and the reaction chamber is 13½ in. square in section.

The TPC process, mechanically, is an outgrowth and adaptation of the principles developed by Socony Vacuum in connection with its Thermofor catalytic cracking (TCC) process for the production of gasoline. The plant consists essentially of a pebble heater utilizing a moving bed of solid particles as a medium of heat transfer. This and similar processes have received wide acceptance by the petroleum industry and there are approximately 60 units in operation today. The mechanics involved in the handling and flow of continuously moving beds of solid particles are, therefore, well established.

The thermal cracking of liquid feedstocks carried on in the TPC process departs considerably, processwise, from the catalytic cracking of hydrocarbon liquids. Heavier feedstocks are used and more carbon is laid down which resulted in the choice of solid carbon particles rather than ceramic materials as a medium of heat transfer. Higher temperatures and a much greater severity of cracking are involved. It was to investigate the effects of these process changes that the pilot plant was constructed and operated.

The process is shown schematically and its operation described in *Fig. 2.*

In a commercial unit, the gas will flow from the gas offtake through a column where the condensable liquids will be separated into fractions. The pitch and high boiling point liquids will be removed from the bottom of the column and the lighter oils, fixed gas, and steam, which enters the unit through the steam seals, will pass off as an overhead product. Final cooling will take place in an indirect condenser in which the light oils and steam are condensed. The liquids from the condenser will flow into an accumulator where separation of the hydrocarbons and water takes place.

In addition to the two pebble streams which have been described, provisions are made in the pebble circulating system for removing fines which may accumulate during the circulation of the pebbles and for removing oversizes and excess pebbles resulting from the deposition of carbon during the cracking process.

Two features of the process are essential to its successful operation and should be stressed. The first of these is the use of a quench chamber for reducing the temperature of the vapor products before they leave the cracking unit. In other attempts to utilize similar means of cracking, at high degrees of severity, serious difficulty has always been encountered in continuously removing the cracked products from the system. Offtake pipes and chambers have filled with a deposit of pitch and coke. The use of a quench chamber, in which the temperature of the products is dropped below the point where coke and pitch deposition is a problem, is a distinguishing

HERE ARE THE RESULTS

1. The soundness of the theory which resulted in the adoption of a pebble quench has been established. The unit will operate for prolonged periods of time under severe cracking conditions without stoppages resulting from the deposition of pitch and coke in the gas offtake.

2. The plant provides a continuous process which can be so instrumented as to provide panel board control and operation.

3. When operated at a cracking temperature of 1590° F and cracking reduced crude of the following specifications:

Specific gravity, °API	19.7
Viscosity, Saybolt Furol Seconds at 122° F	126
Conradson Carbon residue, wt. %	7.07
C/H ratio	7.32

The liquid products were very fluid and gave no handling difficulties. The analysis of these liquids is given below:

Specific gravity 60/60	1.046
Free carbon content, wt. %	0.02
Unsulfonated residue/100 gm.	0.00
Viscosity at 122° F SUS	34.4
Approximate composition, wt. %	
Benzene to naphthalene, 158° to 392° F	29.1
Naphthalenes, 392° to 500° F	13.5
Heavy aromatics and cyclics, 500° to 672° F	19.0
Pitch	38.4

The condensable liquids are characterized by a low carbon content (.02%), a low pitch content, 38.4% as compared to a normal pitch content of 55%, and a high aromatic content.

4. An average gas analysis taken during the last period of operation is as follows:

N_2 and CO	2.6	C_3H_6	3.0
CO_2	1.0	Butenes	0.4
H_2	30.6	1, 3 Butadiene	1.0
CH_4	36.1	Cyclopentadiene	0.2
C_2H_6	2.6	Acetylene	0.5
C_3H_8	0.2	Benzene	0.8
C_2H_4	21.0	Toluene	*trace*
Total	100.0		

On a flue gas and aromatic free basis the gas had a heating value of 993-Btu/cu ft and a gravity of 0.574. This is well within the range specified originally for an ideal oil-gas process. The gas as analyzed above was contaminated with approximately 1.5% of flue gas which will not be present in the gas from a commercial installation.

This gas was produced at a cracking temperature of 1590° F. The heating value can be readily controlled by increasing or decreasing the cracking temperature. The writer is confident that a 950-Btu gas with a gravity of .55-.57 can be continuously produced. Such a gas should be readily substitutable with high methane natural gas.

5. Yield of gas, liquids and coke when operating with the feedstock already described and at a cracking temperature of 1590° F are as follows:

Gas:

Btu/gal. feedstock: 83,500 on a C^5 or less basis

Cu ft (993 Btu, 0.574 sp gr): 83.9

Liquids:	Wt. % of feed	gal./gal. of feed
Condensed from wet gas	31.7	.285
Benzene from gas	1.2	.013
Total	32.9	.298

Coke:	Wt. % of feed	lb/gal. of feed
Total deposition	22.2	1.7
Net recovery	16.8	1.3

6. Based on heat balance figures obtained during the operation of the pilot plant, it is estimated that a commercial plant will require a fuel input amounting to 31,400 Btu per gal. of feedstock. At the present stage of development this heat can be supplied either by burning make gas or by burning the carbon which is laid down as coke. This heat requirement is based on the use of a feedstock having cracking characteristics similar to the reduced crude used experimentally and on cracking conditions having a severity sufficient to produce a 950-1000 Btu true oil gas. It will, of course, decrease as the severity of cracking is reduced.

feature and contribution of the TPC process.

The second important feature of the process is the use of coke pebbles as a medium of heat transfer. Carbon which is laid down during the cracking process deposits on these pebbles and results in a continual increase in the total volume of pebbles in the system. Since any increase in the volume is continuously removed from the system, the process is not affected by the amount of carbon laid down and, consequently, the system can use any type of feedstock available regardless of its carbon content. The fact that more carbon may be laid down than can be utilized as a source of heat for the process is not a limitation since any excess carbon is removed as a by-product.

The operation of the pilot plant terminating with a five-day run during the week of March 16, 1953, during which yield figures were obtained, has provided sufficient operating information reported under "Results of the Test."

The results obtained to date from the operation of the pilot plant indicate that the TPC process basically meets all the requirements originally specified for an ideal oil-gas process, particularly requirements 4 and 5. It is gratifying to note that, if conditions warrant, a 950-1050 Btu gas of 0.55-.60 specific gravity can be produced continuously with no tar handling difficulties.

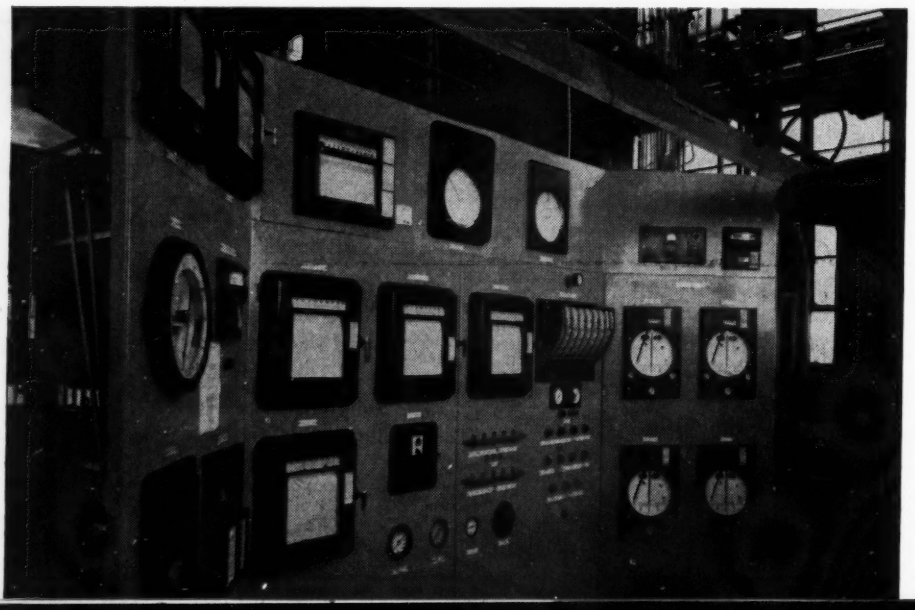
The evaluation of the liquid by-products produced at this cracking level has been disappointing when based on existing standards for the market value of oil-gas tars. A further investigation of the constituents of these liquids may develop new markets and an enhanced value. It should be remembered, however, that the initial experimental work was directed toward producing a better gas than could heretofore be produced and that the choice of operating conditions was dictated by the character of the gas and not the liquid by-products.

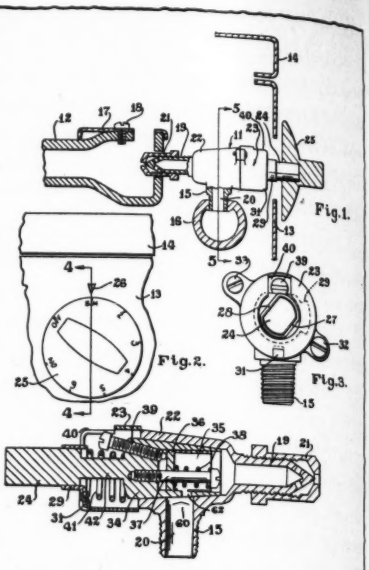
It is recognized that a gas of less desirable characteristic may be satisfactory in many utility situations. Under such circumstances, it is perfectly feasible to operate the TPC process at lower cracking temperatures, chosen to produce liquids of maximum market value, controlling the heating value of the gas by an admixture of inerts at the expense of a higher specific gravity. The process has the flexibility necessary for operation at the most economic level with respect to by-product credits when gas quality is not a limiting factor without sacrificing its ability to produce a high quality gas, when necessary, without loss of plant capacity.

It is admittedly desirable to conduct a further investigation of the effects of varying operating conditions on yields and product quality. The next major step, however, is the expansion of the design from 250 Mcf per day to 5 MMcf or more per day. This step presents problems which should not be minimized. They are, however, mechanical rather than process problems and relate primarily to the physical design of a commercial unit.

Many of the problems incidental to this next step can be simplified by drawing on the experience of the petroleum industry in its evolution of the continuous catalytic cracking process. From the standpoint of design and operation, the two processes have many characteristics in common and the petroleum industry has demonstrated that commercial units can be successfully constructed once the design fundamentals are accurately determined in actual pilot plant operation.

Fig. 3. Control instrument panel for TPC pilot plant.





Graduated range valves perfected

A GRADUATED valve has been designed for use on various types of gas appliances. The valves as described in patents covering the inventions are especially designed for use in controlling the cooking top burners of kitchen ranges, but it is to be understood that the inventions involved clearly have other uses. Thus they may also be useful in the control of gas oven burners. The inventions may also be used for the control of gas outside of the cooking field such as in gas heating appliances. They may even be used for control of other fluids, including liquids as well as gases.

This application is in part a continuation of co-pending, earlier filed applications Serial No. 776,687, filed Sept. 29, 1947; Serial No. 7819, filed Feb. 6, 1948; and Serial No. 27,167, filed May 15, 1948.

The valves illustrated are designed so that not only may the gas be turned on and off, but also the size of the flame may be varied as the valve is rotated from the "on" position to the "off" position, or from the "off" position to the "on" position, or from the "on" position to the "simmer" position, etc.

I. Vernon Brumbaugh
Pat. No. 2,650,612

The TPC process has possibilities which can permit the control by individual utilities of the load factor on transmission line deliveries. It also has potentialities beyond this. With by-product credits based on liquid by-products of superior physical and chemical properties and with enhanced market values, the process gives every promise of becoming a practical base-load production process capable of producing gas at a very low net cost.

GAS exclusive

They're telling the world* about their jobs

**or, at least, the several millions who use gas and electricity in New York.*

By **NORMAN P. JOHNSON** • Consolidated Edison Co. of New York

EMPLOYEE interviews, some skeptics warned, don't work satisfactorily into TV commercials. A flubbed line, a wrong cue and the employee is left like a fish out of water while the home audience suffers with him.

But George T. Minasian, director of community relations, and his staff at Consolidated Edison in New York believed otherwise. They saw the TV commercial as an ideal medium for telling Con Edison's story, with employees doing the telling.

Nine months of experience proved the skeptics wrong—at least so far as Con Edison is concerned. Once a week, since early in the year, Con Edison employees have appeared in short TV commercial interviews with remarkable success.

They appear on "Telepix News," a twice-daily program of local and national news events which Con Edison sponsors over WPIX, a New York City station, six nights a week.

One primary reason for the success of Con Edison's TV employee interview commercial (and a clue to why others may have failed) is the informal, unstaged and natural manner in which the interview is handled.

As Mr. Minasian describes it, "Our interviews avoid the canned-talk effect. There's no set script or lines to fumble, no notes to glance at."

The Con Edison men and women, from all walks of company life, who have appeared to tell their story briefly—what they do, how and why—easily could be Mr. and Mrs. "Average New Yorker," a relative, or neighbor of almost anyone in the unseen audience.

There's a saying, "a city mostly is people," which applies equally to Con Edison. For Con Edison mostly is people—more than 27,000 people. On TV, as in every day life, they *are* Con Edison. They meet the public daily, answer questions, solve problems, even help deliver babies and, last but not least make utility service possible.

Con Edison, in sponsoring two popular local TV shows in the New York metropolitan area, Telepix News on WPIX and the "Uncle Wethbee" local weather reports on WNBT, doesn't at-

Interviewed before TV camera by Telepix Newscaster Tillman (right), Mrs. Irene Baker, ConEd placement bureau manager, described vacation-time jobs for students and opportunities for new grads. Other guest, Tom Paterno told how he got his start at ConEd right after high school graduation.

Joseph Geoghegan, superintendent in holder maintenance and painting at ConEd's Hunts Point gas plant (left) and Mechanic Danny Lollo, (center) used models to demonstrate ConEd's flotation painting method for TV Announcer Fleetwood and TV audience.

tempt to buck high-cost, elaborate TV programs for audience attention.

"We are not primarily in the entertainment business," Mr. Minasian will say. "We can't, and we don't, try to compete with network entertainment. Ours is a local, community-interest, public service type of program schedule, in keeping with the local utility services which Con Edison provides. And the employeee interview commercial appropriately fits into that pattern."

The interviews are as spontaneous and unrehearsed as possible. Naturally, the general tone is set beforehand. John Tillman, the newscaster, and his guest talk over briefly what they will cover on the air and selection of topics is not left to the last minute. But guidance is limited to a general outline. The guest speaks in his own words, each according to his manner.

Broad in scope, the interviews have included employees engaged in specialized work—the kind where you can say "he is a gasman"—as well as those who cannot be identified with the consumer product. Together they present a cross-section of Con Edison.

One of the first interviews featured the manager of the personnel department's placement bureau, a photogenic, personable woman who discussed, early in the year, summer vacation job opportunities at Con Edison for high school students and new graduates. It was the success of this interview, actually, which led to a regular, planned schedule of weekly employee interviews.

There are other examples of the "general subject" interview. The editor of Con Edison's employee magazine appeared to tell how the company keeps in touch with employees away in the armed forces; recently Mr. Minasian was on the show himself to review Con Edison's plant expansion and smoke control programs; and, earlier, a union official was chosen to describe the annual charities drive, jointly sponsored by the union and the company.

Such interviews present less known, sometimes unpublicized, nonetheless typical local activities that are part and parcel of Con Edison's responsibilities in "belonging" to the community.

To focus the TV camera on Con Edison's operating functions, other interviews tell the story behind specific jobs, featuring men in various departments.

Gas operating people have been well represented. Mr. Tillman's guests have included a meter reader, a meter repairman, and men concerned with diverse gas plant operation and maintenance functions.

The "gas story" was told recently in three successive interviews. First, a senior plant operator at the Hunts Point plant outlined generally the gas manufacturing processes used there.

A week later, another man told how coke ovens work; and the next week Hunts Point's oven gas superintendent explained how coke oven and water gas are blended together, along with natural gas, to produce the mixed gas used in many metropolitan area homes.

Sometimes, only when appropriate since time is a factor in a two-minute interview, human interest details are included. A gas operations man, assigned to gas holder maintenance and painting, told of a rescue operation high up on a Hunts Point gas plant stack for which he received a Carnegie Hero Fund metal.

Or, to cite another case, an electric station superintendent when asked if his job allowed time for outside activities, revealed he'd been mayor of his home town for six years.

Visual aids are used whenever possible. On TV this is a "natural." The meter repairman brought a gas meter, typical of most home installations, and explained its workings—a point of obvious interest to any home owner who's watched the "little wheels go 'round."

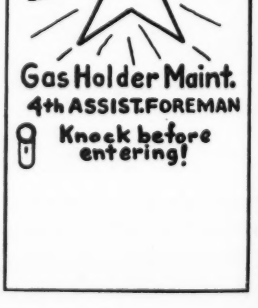
A gas holder maintenance and painting superintendent exhibited two small-scale gas holder models, as he described the flotation painting method used on the giant holders which New Yorkers often see—and seldom admire, despite the effort to keep them as unobtrusive as possible. Obviously, the models made his story simpler to tell, and easier for the home audience to follow.

Employee interviews, also, have a definite morale boosting factor. An appearance on Telepix News is remembered as a pleasant experience and perhaps a memorable evening.

The employee glimpses behind-the-scenes activity at a TV station, watches other shows in rehearsal or final production, and perchance meets some well-known figure in the entertainment world. One man who walked down the hall chatting with Denise Darcel is still talking about it, but not to his wife.

Con Edison regards the employee TV interview as a worthwhile proposition. New York's TV audience has been introduced to another of the thousands of men and women whose job, big or little, is part of making their utility service possible.

And, the employee who has been interviewed has been introduced to something new, too, behind the scenes in the mammoth, fascinating city which his work helps to keep warm or cool, as the case may be, and lighted.



PR WORKSHOP

Two case histories and a modern idea that can be adapted even by those companies that choose to "go it alone"

When gas leaks spouted at Herscher, public confidence did not waver

By **JAMES F. OATES JR.** • Peoples Gas Light & Coke Co., Chicago

PEOPLES GAS Light & Coke Co. has recently experienced a remarkable demonstration of the high importance of public good will and public confidence at the local level. One of our subsidiary companies, Natural Gas Storage Co. of Illinois, has been engaged for several months in the construction of the first stage of a vast underground storage project involving the use of subsurface strata under some 15,000 acres of land situated in Kankakee county, Ill., near the village of Herscher, a community of about 500 population. Late in July and early in August old water wells in the town of Herscher became turbulent and gas began to be produced in the back yards of the village residents.

The storage company went into immediate action, and built standpipes in order to direct the escape of gas into the air at a sufficient height from the surface of the ground to avoid trouble. These steps, however, could not be taken fast enough to get ahead of an American boy who obviously was "compelled" to scratch a match in the interests of science to see if the gas would burn. It did! The fire was promptly extinguished without injury to anyone. Other and more elaborate measures were taken at once to assure the public safety.

Other water wells began spouting like geysers and old abandoned oil wells in the neighborhood, some of which had long since been obliterated and forgotten, began to produce gas. The situation was a momentary nightmare. We had injected some 7½ billion cu ft of gas into the storage reservoir at pressures in excess of 700 psi, which was the approximate hydrostatic head of the salt water occupying the sand in question. It took little imagination to visualize the inhabitants of the town marching on the compressor station and demanding that all activities cease from thence forth forever more.

But the people of Herscher and its environs trusted our enterprise. They knew that we were doing everything within our power to protect their interests because they knew our people and had known them for many months. They also knew that we would keep them fully informed and tell them the truth and nothing but the truth. At the first word of the difficulty, Joe Hancock, formerly of Amarillo, now of Herscher, the superintendent of the storage project, went to the village president whom he had learned to know over a period of many months and assured him that all of the manpower and facilities of the enterprise would be put to work to find the source of the difficulty whether we were responsible for it or not, and that the people of Herscher would be fully protected.

". . . old water wells in the town of Herscher became turbulent and gas began to be produced in the backyards of the village residents."

". . . issued a full and factual story to the Kankakee, Ill., newspaper."

Within a few days our organization, with the help of independent geologists and consultants after preliminary examinations, issued a full and factual story to the Kankakee, Ill., newspaper which ran an article in a matter-of-fact tone revealing all those elements in the situation which were favorable to the company. Later the Chicago papers ran stories. I am the proud possessor of a letter from one the chief editors of a great Chicago newspaper thanking our organization for the promptness, candor, and fairness with which all of the facts respecting Herscher had been reported.

We shall be eternally grateful to the

This article has been digested from a paper presented at the annual meeting of the INGAA in Houston, Sept. 29.

people of Herscher for their patience and forebearance in our struggle for the solution of the problem, which solution now happily appears at hand. No one can convince me that the people of Herscher would have been so understanding if our storage company people had not become a part of the community and if we had not earned and deserved the reputation of telling the truth. This, I believe, is real evidence of good public relations at the local level in a crisis.

Now, I believe it is safe to say that we are well on our way out of the woods. After we had fully protected the town of Herscher, we engaged in substantial supplemental drilling. This work conclusively refuted the possibility of a major fault in the structure. That ghost I can happily report has been well laid. The final step of our three-part investigation consisted of a painstaking, detailed examination and test of each of our injection wells and all parts thereof to find the cause or causes of the difficulty. We have discovered by the use of highly interesting and modern electronic equipment a casing leak in one of these wells. We are not assuming that this leak is the sole cause of our difficulties and we are now concluding a thorough and further testing of all wells. But we can report with considerable satisfaction and confidence that when the guilty well was immobilized the production of vented gas fell off tremendously in quantity. There are those of us who believe that the leak we have found is *the* leak.

These developments as here reported were promptly and fully reported to the Chicago public through the issuance of press releases and the simultaneous printing of concise factual advertisements. The public was told everything and guaranteed nothing. We have been heartened and encouraged by the fact that our investors and our customers alike have responded with understanding to our factual, candid reports.

We have been convinced for some years that good public relations can come only from public confidence and public confidence can come only from taking people into our confidence. But, let me say this: if we had ever wavered anywhere along the way in this belief, the belief would have been restored more solidly than ever before by our experiences in the Herscher matter. By frankness and a willingness to tell the people the facts, it seems overwhelmingly evident that we are regarded by the people of Herscher, by our investors, by the press, and by the Chicago public—including the disappointed members on the waiting list for gas heat—in a far better light than we would have been had we tried foolishly to stick our heads in the sand or to slam doors in the faces of those having a right to know the truth.

". . . he would not ask a home service girl to speak on a technical subject before a woman's group."

Key components of a PR organization: formal and informal speakers' bureaus

By **MARSHALL NEWCOMB** • Lone Star Gas Co., Dallas

IN setting up a speakers' bureau program, the first thing we should do is make sure that our employees, and particularly the ones who occupy key positions in our organization, have a prominent part in furthering this program. They are the ones whose voices are more likely to be taken as representative of the policies of our respective companies, and the ones who are likely to be called upon on many and varied occasions to defend or explain our positions. Hence, they are the ones who should first be prepared to discuss forthrightly and forcibly all of the general facts, circumstances, and policies that pertain to and affect our relations with the general public.

As a part of the speakers' bureau of any company, we must take into account two elements: the informal bureau, which is represented by a large segment of employees, and a specialized bureau which is represented by select personnel who are well rounded in the knowledge of the industry's problems, its accomplishments, its aims and purposes, and the points of attack upon it.

Let the informal or general employees' speakers' bureau be drawn upon by the formal speakers' bureau. In fact, it might be a good way to test the effectiveness of the formal speakers' bureau, for certainly if they could not make a worthwhile and constructive group of advocates out of their fellow employees as a whole, they would find it difficult to make a favorable impression or obtain favorable results with the general public and with those outside of the organization.

Study club

Several years ago a group of employees of my company organized an evening study club. They sought information about the various phases of our company's activities with which they did not come in contact in their respective jobs. This group meets one evening in each month, at which time they are addressed by a company representative who is either an over-all executive or who heads a particular department of the company, or who is specialized in a particular field of activity.

As a result of this increased knowledge of company affairs, this group has been able intelligently to discuss the company's affairs with the general public and to meet criticisms based upon misinformation and jibes based upon prejudice and ignorance. Such a procedure suggests at least one means of creating a speakers' bureau within a particular company.

The highlights of organization of a company formal speakers' bureau are as follows:

1. Organization of a speakers' bureau in your company.
2. Delegation of authority to supervise the operation.
3. Training of speakers.
4. Coordination with INGAA headquarters.
5. Obtaining the proper news coverage of each speech.

The first thing to do in organizing a company program is to appoint one person in the company with sole responsibility for this activity. This should be a job for one of the top executives who

This article is a digest of a talk presented at the INGAA workshop in Dallas, Sept. 10.

should take it seriously. Once this authority is delegated to a responsible executive, a long-range plan can be undertaken to provide speakers for appearances in the company's operating territory.

As an initial step, the head of the company speakers' bureau should survey his company personnel, at all levels, to provide a variety of speakers for the various types of local groups before which he will have an opportunity to place speakers. He also should make up a record—possibly from a recruiting questionnaire—of the experience of each one of the speakers he recruits for the activity.

Once he has counted his voices and knows their capabilities, he should match the subjects available to the speakers' training and background as closely as possible.

Appearing in public, even before small groups, requires some experience and training. To help their speakers, some companies may wish to sponsor a short training course on company time.

In this connection, if you do nothing else in your training program, see that your speakers have access to the INGAA speakers' kit. It will be a guide to them on national industry statistics, facts, and problems with which we are all concerned. If you decide to sponsor a speakers' training course, study of the kit should be made a part of the course to provide your speakers background on national problems of the industry.

The second step in operating or setting up your speakers' bureau is to line up speaking dates on an organized basis. The head of the bureau should have at his fingertips this kind of information: the names, addresses, and phone numbers of program chairmen for every kind of business, civic, garden and social group in the operating territory. He should know the groups' meeting dates and places.

Once the chairman has his list compiled, he then should embark on a program to acquaint the program chairmen with the speakers, subjects, and facilities available from the company bureau. Some of the tools for acquainting program chairmen with the activities of the speakers' bureau include news releases throughout the territory on the formation or operation of the bureau; an announcement letter to the program chairmen advising them of the bureau to tie in with the impact of the news release; and bulletins or employee publication stories about the bureau, and inviting employees affiliated with various groups to publicize the bureau to those groups.

In discussions with program chairmen, the speakers' bureau chairman should see how he can fit the list of subjects—community development, freedom of enterprise and the wide range he can offer—into the purpose of the club or its interests. His objectives, of course, should be to see if he can cultivate relationships with the clubs to not only get one invitation to place a speaker before the group, but also to make this an annual arrangement.

Films? By all means!

Whenever you have a film, tie its showing in with your speakers' bureau. I am heartily in favor of a short film to accompany any talk.

At the present time, John A. Ferguson, INGAA executive director, is recruiting speakers from operating companies for engagements on a national, regional, and state basis before other gas and oil associations. After that program is developed, it is his aim to place speakers before other industry, professional, and association groups. The policy is to place such speakers at appearances within a day's travel of their headquarters.

So, if we can uncover a good speaker for the INGAA national bureau, let's not keep him hidden in our area, but give him an opportunity through INGAA to go to work for the rest of the industry.

The national bureau will assist you in placing speakers at national meetings; provide your speakers with research help and materials to build their talks, and also coordinate national news coverage of such talks with your local news releases on them.

But the job actually is not complete until the company news department or the man in charge of company news releases gets the information on the speaking engagement and the text of the talk. Then he can go to work. In case of major talks, he should send out text and digests of speeches in advance to the local press, radio, and television. And no speech should be made by a company executive or representative without at least an advance story on that talk going to the press of the territory and to the press associations. A proper follow-up story with appropriate quotes from the talks should be sent out when the speech is made.

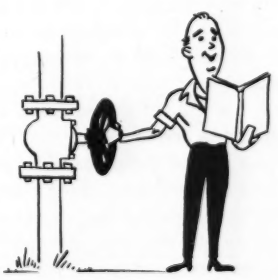
When employees spoke for company a needed rate increase went through

By **M. H. NORTH** • Oklahoma Natural Gas Co., Tulsa

UNINFORMED or misinformed employees can hurt their business (and yours) because in their own circle of acquaintances they speak with even more authority than does management.

About two years ago, we were preparing to apply for a rate increase. The most important single factor in that preparation was completely acquainting our employees—all our employees—with all the facts regarding the necessity for the increase and the step-by-step procedure which the company would follow in preparing its application and presenting its case to the corporation commission.

We first held evening dinner meetings for all employees, their wives and husbands. At this meeting our president announced our intention of applying for a new rate, and then showed in a series of illustrated slides what had happened to the company over the past 10 years with graphic illustrations of the increases in costs of doing business in terms of the employee's own family budget experience over the same period, pointing out that individual employees had been able to solve their family budget problems because their income had increased with



". . . they were provided with additional facts and figures in pocket size booklet form."

This article has been digested from a talk presented at the INGAA workshop conference held in Dallas, Sept. 10.

their family expenses, while the company had had no increase in income, and after reducing its expenses and increasing operating efficiencies to the limit, then had but one alternative—to get a "pay raise" in the form of a rate increase.

Employees aid cause

The story was crystal clear to every employee, because it was told in terms of each employee's own experience. Printed copies of the facts, figures, and illustrations on the slides were passed out to all employees at the end of the meeting.

That initial meeting was followed by local group meetings in each of our districts in which each employee was told how he could assist the company in its application for the rate increase—by telling his friends and neighbors and acquaintances the company's story.

Employees up and down the line were then delegated to take the story to their local newspapers, their local city officials, their chambers of commerce, their local municipal, county, and state officials, including the local representatives in the legislature, their civic groups, social groups, right on down to individual customers—their friends, neighbors, and acquaintances.

They were provided with additional facts and figures in pocket-size booklet form. This booklet was titled "Information Regarding the Necessity for an Increase in Gas Rates." The material was presented in question-and-answer form and the questions were those which it thought most likely would be asked by customers.

No protests

To make a long story short, our case came up before the commission. Not one of the 100 newspapers in our area printed an editorial in opposition to our application. Not one of the cities or towns we serve (more than 100) registered a protest. Three or four towns only were represented at the hearings. These representatives appeared at the first hearing to reserve their right to protest later if they so desired, but it was entirely routine for they didn't even appear after the first day. We did have one problem with a group of industrial customers. This problem was settled through direct contacts with these industrial users—again a matter of communications.

Our increase was granted. We supplied our employees with follow-up information, a second employee booklet entitled "Facts About the Company's New Gas Rates and How They Will Affect Gas Users," and our new rates went into effect without a ripple.

Do our employees give a hoot? Will they listen to what we want to tell them? All of the evidence says that they do and they will. For example:

Last year the National Industrial Conference Board, as part of a study on communicating with employees, distributed a questionnaire to 650 employees in two different plants of a manufacturing company. They asked the employees to vote on the things they would most like to know more about. Leaving out two items that referred to the union, the top subjects of interest to them they listed as follows:

The company's future prospects; how promotions are decided; how American business works; things the company makes; pay of company officers; reasons for firing workers; company profits; how my pay is figured.

GAMA joins competitors in fight to kill appliance excise taxes

A CAMPAIGN to bring an end to "unfair and discriminatory" federal excise taxes on electric, gas, and oil appliances has been launched by representatives of three organizations of appliance manufacturers.

GAMA, the Oil-Heat Institute, and the National Electrical Manufacturers Assn. plan to enlist the support of an estimated 3500 appliance wholesalers and 140,000 appliance retailers in a campaign to bring facts about the excise taxes to the attention of Congress and the administration.

The action has been undertaken at this time because, as Reese Mills, chairman of the excise tax advisory committee of NEMA, told a recent press conference, ". . . this coming year Congress will undoubtedly consider a number of proposals for revising the Federal tax structure and the industry is anxious that Congressmen be informed as to the necessity for repealing the tax on appliances. Declines in the sales of appliances show that the excise taxes are having a serious effect upon the sales of these products."

The three manufacturing groups are enlisting the support of their members, and the support of retailers and distributors in a substantial effort to inform senators and congressmen why the excise tax should be repealed.

Some of the major reasons outlined by the group are as follows:

1. The taxes, originally imposed during World War II, were levied to discourage consumer buying of appliances to conserve scarce metals.

2. The taxes are discriminatory in that they are extra taxes to which many other durable and nondurable goods are not subject.

3. The appliances on which the taxes are levied are essentials to modern living and are no longer luxuries.

4. The income from these taxes represents only one-fourth of 1% of the government's tax revenue, which, if removed, might well be offset by increased revenues resulting from better business.

5. Excise taxes on appliances work a direct hardship on five major groups: manufacturers, wholesalers, dealers, and employees of all firms in the appliance business, as well as consumers of these products.

6. The ratio of the production of appliances to over-all national production has shown a substantial loss over the past three years, a fact which indicates that the tax is having a serious impact on sales.

During the press conference, GAMA asserted that while excise taxes served a useful purpose in producing revenue during great emergencies, they have now outlived the emergency and have "become a serious deterrent to sales and a threat to a segment of industry which plays an essential role in sustaining the national economy and living standard of the American people." GAMA went on to add several more reasons why the taxes should be repealed:

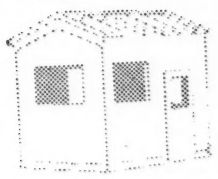
1. They cost the consumer far more than the actual tax received by the government.

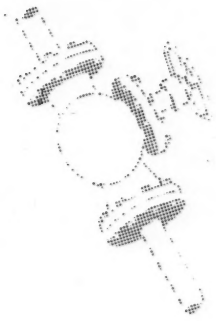
2. They have inflationary effects.

3. Because sales drop, there is a decrease in production, which affects the livelihood of thousands of workers engaged in the production, distribution, and sales of taxed merchandise.

4. They create a form of rationing by pocketbook, by pricing appliances out of reach.

5. They are concealed taxes—hidden from the consumers who actually pay the taxes.





Designing a city gate station

Part 2. *Remote transmission, dispatcher operations, characteristics of the gas and scrubbing; and a brief outline of the design elements of an ideal station.*

By C. S. BEARD

This is the concluding installment of a two-part article on designing a city gate station. For a full discussion of other design elements including selection of a site, housing and landscaping, equipment placement, pipe and fittings, gas measurement, relief valves, pressure regulators, and measurement ahead of and after regulation, see October *GAS*, page 60.

REMOTE TRANSMISSION

Variables which are necessary to gas measurement and control may be transmitted from the station where they are measured to some distant point. This transmission may be accomplished pneumatically (pneumatic transmission) or electrically (commonly called telemetering).

Pneumatic transmission is limited as to distance, depending upon the speed of response desired. This type of transmission *(Fig. 39)* consists of a system in which the measuring element may vary the pressure in the tubing connecting the transmitter and receiver in direct ratio to the change in the variable. The receiver is a pressure gauge calibrated in terms of the transmitted variable so that the low point occurs with 3 lb on the connecting tubing and the high point occurs with 15 lb. The use of remote central control boards has brought about a wide variety of well-designed transmitters. A manual remote setting of a controller or control valve may be obtained using a pressure regulator *(Fig. 40)* which will give the controlled output pressure whether it constitutes an increase or decrease in existing pressure. For this use the controller is designed with a receiver bellows which will mechanically position the set point of the instrument. Re-setting of the set point of a pressure controller by pneumatic remote transmission may be accomplished as shown and explained in *Fig. 41.* The use of non-indicating controllers *(Fig. 42)* increases the utility of transmitting systems without undue duplication of recorders and indicators. Local controllers eliminate transmission lags which contribute to hunting.

Each variable may be transmitted to a dispatcher's office. Within the limits of legibility, these may be recorded on one chart. Duplicate recordings or indications may be shown at other locations including the local board at the city gate station. Six pneumatically received impulses may be recorded on the instrument *(Fig. 43)* which uses one pen arm to record with six different colored pen points within a short period.

In addition to the remote transmission of pressure and differential, it is possible to readily transmit the values of the other variables which affect measurement or adherence to the contract. A non-indicating temperature transmitter may be used, although it would be more straightforward to install the transmitting assembly in the temperature recorder on the local board. Manufacturers of specific gravity recorders have within the last few years adapted pneumatic transmitting assemblies to their equipment. In *Fig. 44* one familiar gravitometer has been converted to an indicating transmitter. Control may be obtained by using a receiver-controller.

Inasmuch as the recorder of the standard calorimeter is a potentiometer, the pneumatic transmission mechanism which has been designed for this type of instrument is applicable. Under most circumstances the use of the electrical output for transmission would be much easier than converting to a pneumatic impulse. This approach applies to analyzers or measurements using thermocouples or resistance bulbs.

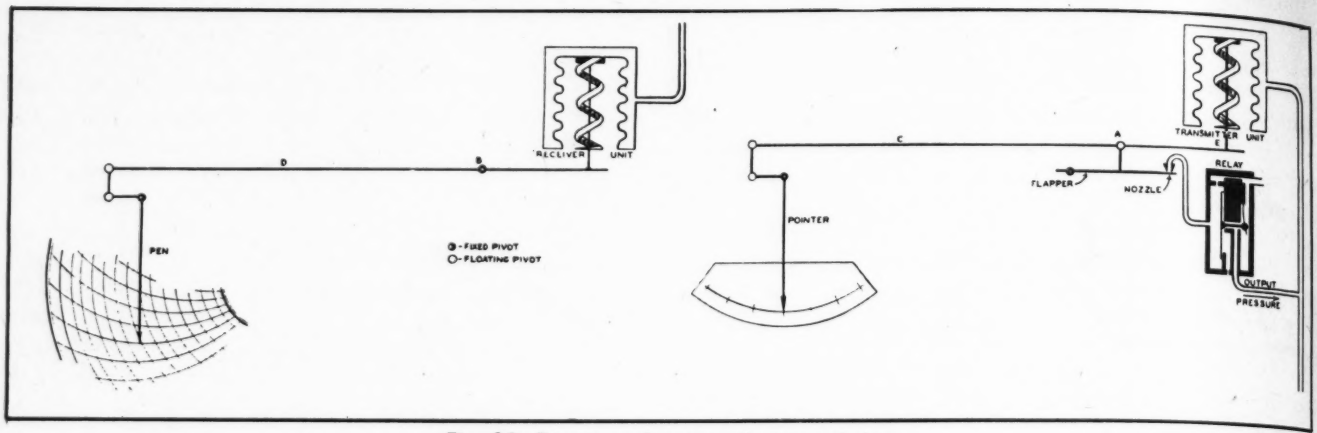
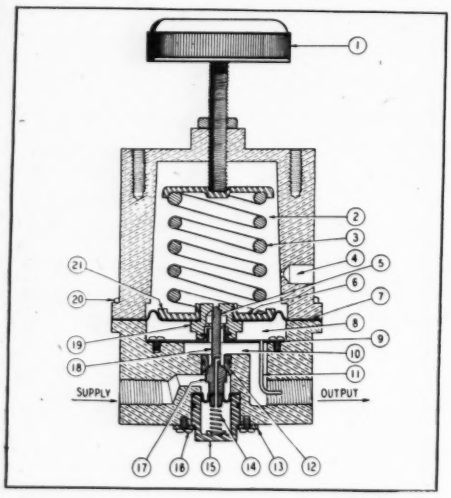


Fig. 39. Diagram of pneumatic transmission. Foxboro Co.



Foxboro Co.

Fig. 40. Loading regulator allows rapid and positive increase or decrease in loading of diaphragm motor.

Pneumatic transmission of necessity requires a source of clean dry air or gas at a minimum of 20 psig. This is usually available where it is advantageous to use this approach. City gate stations located near a steam-electric station, as well as gas generating stations, or compressor plants, use these methods. Gas is rarely used for pneumatic transmission although it can be used with due consideration of safety and the necessity of obtaining gas that is clean and dry.

Telemetering finds wider application in city gate station operation than does pneumatic transmission, because the distance between transmitter and receiver is unlimited. The time impulse system is used extensively even though the trans-

Fisher Governor Co.

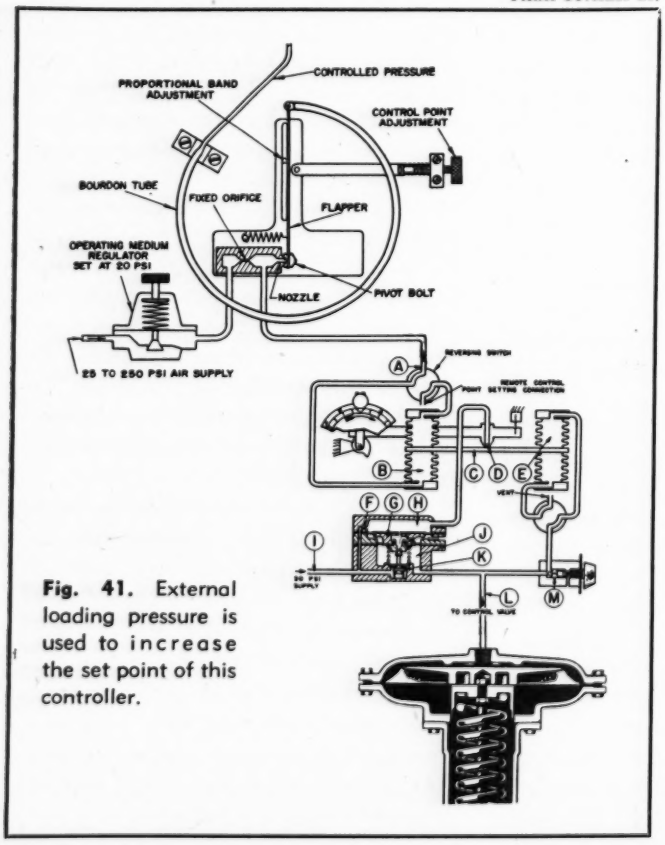
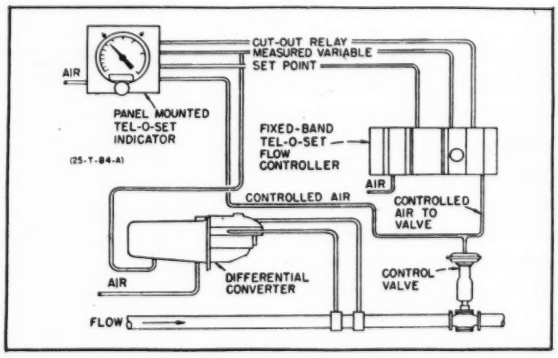
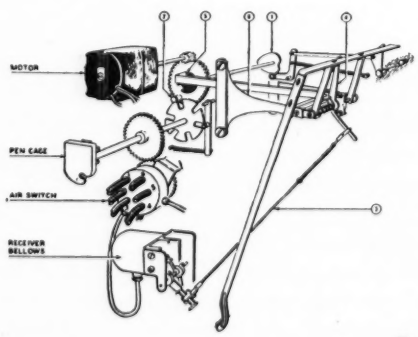


Fig. 41. External loading pressure is used to increase the set point of this controller.

Fig. 42. Pneumatic control system uses non-indicating transmitter and stack controller.



Minneapolis-Honeywell Regulator Co.



Foxboro Co.

Fig. 43. Six pneumatically transmitted variables are recorded with multi-colored traces. Six different impulses are brought to the air switch. At intervals each impulse is impressed upon the receiver bellows. During these intervals the pen arm picks up a new pen point, moves to the proper position on the chart, prints a colored dot, and returns the pen to the holder.

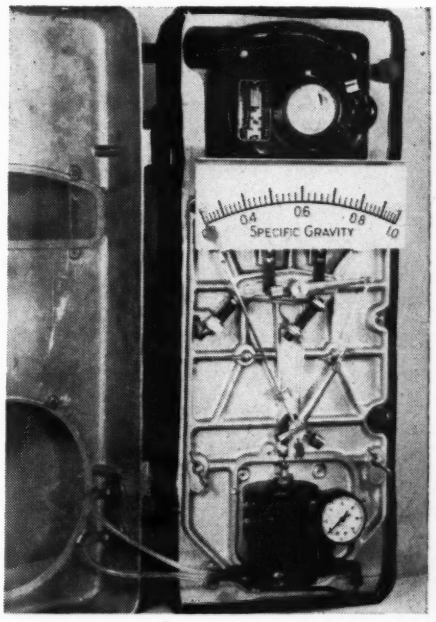
mitter recording is composed of a series of readings taken each 15 seconds. A 5-second cycle is available but not generally used.

Time impulse telemetering consists of a transmitter containing a rotating cam. The position of the indicating pointer, as determined by the value of the variable being measured, determines the proportion of the cam rotation cycle through which the transmitting circuit is energized. In the receiver the recording pen arm is positioned by being moved in one direction during the period in which the transmitting circuit is energized and being positioned in the opposite direction for the period of de-energization. The fact that the reading is periodic does not eliminate this system from city gate station application.

In most cases, telemetering is used for dispatching and not for billing. Applications such as rapidly fluctuating steam loads require the use of a system such as frequency variation which gives a continuous signal and reading. Time impulse is advantageous because of its simplicity, adaptability to commercial power sources, conformation to telephone company requirements, and accuracy through wide voltage changes.

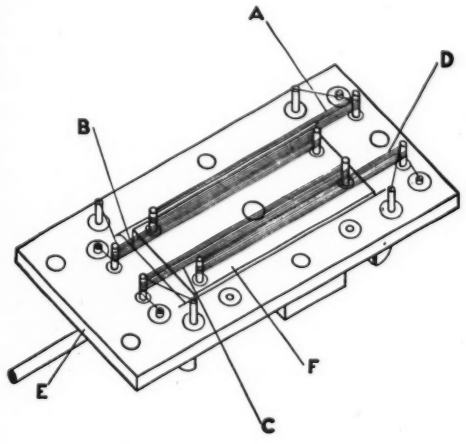
Most telemeter installations used for dispatching take advantage of telephone service. In most cases, leasing a telephonic circuit is more economical than installing and maintaining a circuit. By grounding each circuit, two signals may be carried over the telephone pair. A "multiplexing" unit has been developed to allow as many as 15 signals to be transmitted. The equipment places each signal on the line for a sufficient period to set the receiver. Equipment is available for transmitting a large number of signals both ways through one pair of wires. With this system a piece of equipment, such as a valve, may be selected and the actuator of the valve operated to open or close the valve. Upon completion of the function, the measuring of variables goes on in its predetermined sequence. This type of operation is more applicable to remote operation of a compressor station than to the city gate station.

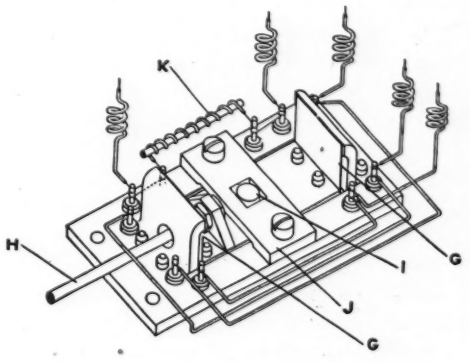
Although it would be possible to make telemetric equipment explosion proof, this is expensive and unnecessary. The



Fischer-Porter Co.

Fig. 44. Specific gravity readings may be transmitted.





Statham Laboratories Inc.

Fig 45. Transducer unit may be used with any element capable of positioning relative to the value of the measured variable.

The displacement transducer element is shown at left. It consists of a frame E, supporting a movable armature F, by two thin cantilever plates. Four sets of strain sensitive filaments A, B, C, D are strung under initial tension between the frame and armature in the manner shown. When the armature is displaced longitudinally, two of the sets of filaments will be elongated, while the other two sets will shorten. The elongated filaments will increase in electrical resistance, while the resistance of the shortened filaments will decrease. The change in electrical resistance of the filaments will be proportional to their change in length. The transducer is so wired that the filaments are connected in a Wheatstone bridge circuit. The resistance change of the filaments alters the electrical balance of the bridge so that an electric current is caused to flow in the output circuit.

The reverse side of the transducer element is shown at right: G is the cantilever plates which support the armature; H is the linkage pin by which movement is transmitted to the armature; I is a stud attached to the armature; and J is a bar attached to the frame. The square hole in the bar J is accurately sized so that the stud I will limit the movemnet of the armature to 0.0015 in. in either direction. The movement limit serves to protect the filaments against mechanical overload damage. The resistor K is a trimmer placed in series with one of the bridge elements: It is adjusted after assembly of the transducer to equalize the resistance of the four elements of the bridge. If the bridge is balanced at zero output before the displacement is applied, the unbalanced electrical output of the bridge will bear an accurate, linear relationship to the displacement.

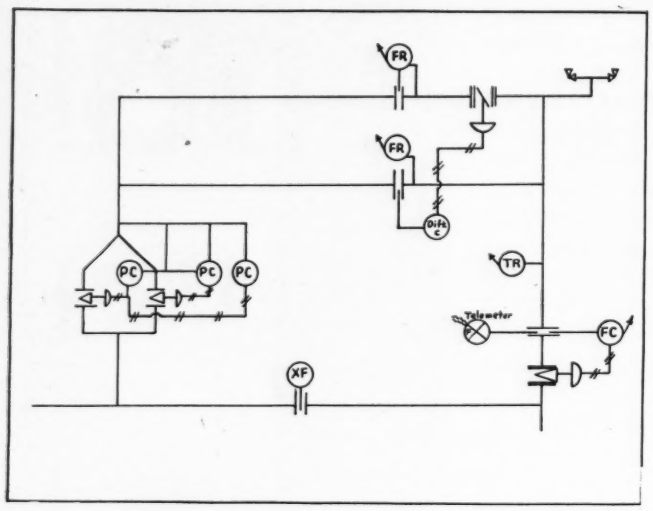
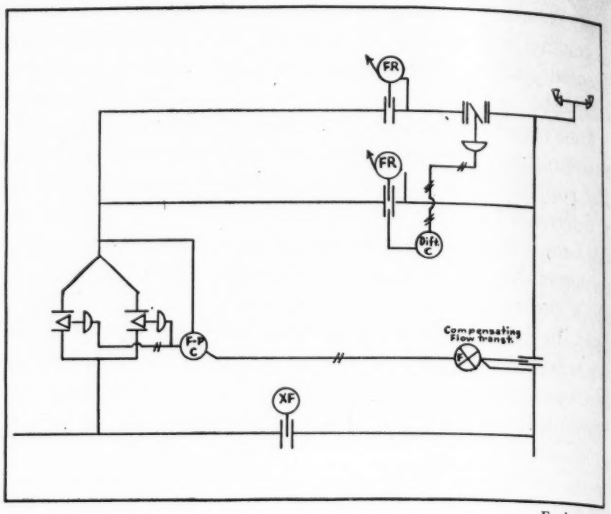


Fig. 46. Flow and pressure control and measurement accomplished with separate instruments.



Foxboro Co.

Fig. 47. Limit control of flow accomplished with Foxboro auto-selector controller.

transmitters may be protected by individual meter houses in the city gate station yard rather than placed in the meter house. The variables can be pneumatically transmitted to the electric transmitters, but this would seem to be an unreasonable approach.

Present trends point toward wider use of electrical methods of measuring static pressure and differential pressure. Transducers utilizing the strain gauge principle are being used in chemical plants and even in highly flammable refineries. These units have been designed for high accuracy and wide range of application. The electrical output is in microamps and consequently is exceptionally safe even in hazardous locations. The use of the same units of electrical output for pressure, temperature, position, or gas analysis obtained with a transducer *(Fig. 45)* makes it possible to record different variables with one type of recording instrument. This approach has not become popular in gas work mainly because present equipment is acceptable and maintenance personnel is schooled in calibration methods which make the present instruments acceptable to all parties concerned.

Notes on instrumentation

Those who have dealt with instrumentation are aware that there are innumerable possibilities and combinations of control systems that can be applied to city gate stations. This is true even though the functions of the station may be only pressure control, flow measurement, and flow control. Flow control, or the limiting of the amount of gas that may be taken through the station, seems to be a necessity at many stations. Just a few of the possibilities will be outlined, in diagrammatic form using modified ISA* symbols.

In *Fig. 46* the functions are carried out separately and in a very straightforward manner. The flow controller would be set at a maximum point using a very limited throttling range.

Flow control as well as pressure control may be accomplished with the same valves *(Fig. 47)*. The flow rate is transmitted using a pressure compensating instrument. The control instrument, known as an Auto Selector†, will control pressure until the flow rate tends to exceed a set maximum. The flow control section will then take over and tend to close the control valve. As the rate of

*Instrument Society of America.

†Foxboro Co.

Fig. 48. Instrumentation system for pressure control with flow rate limit control.

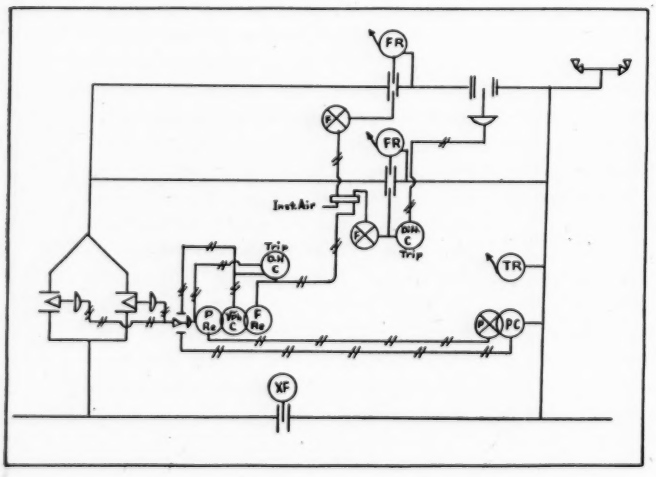
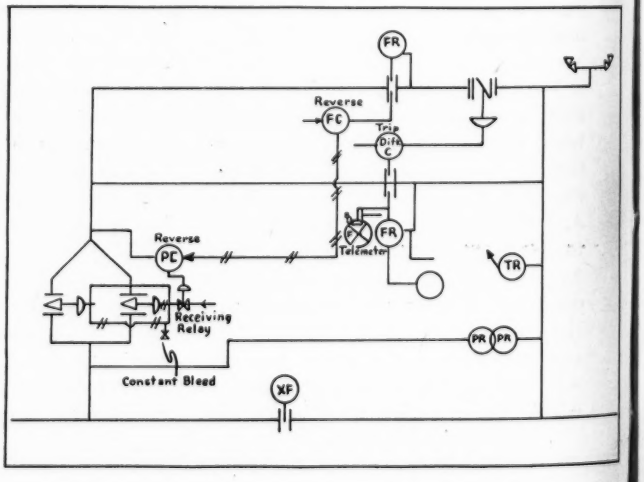
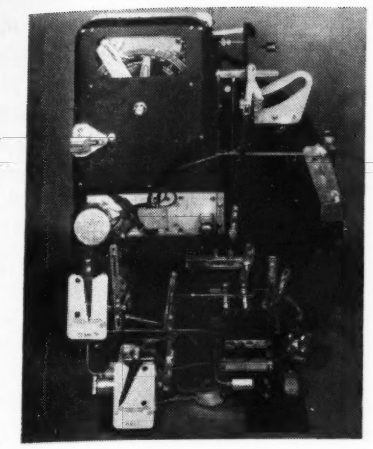


Fig. 49. Differential limit control obtained by using flow controller output as supply pressure for pressure controller.





Penn Industrial Instrument Corp.

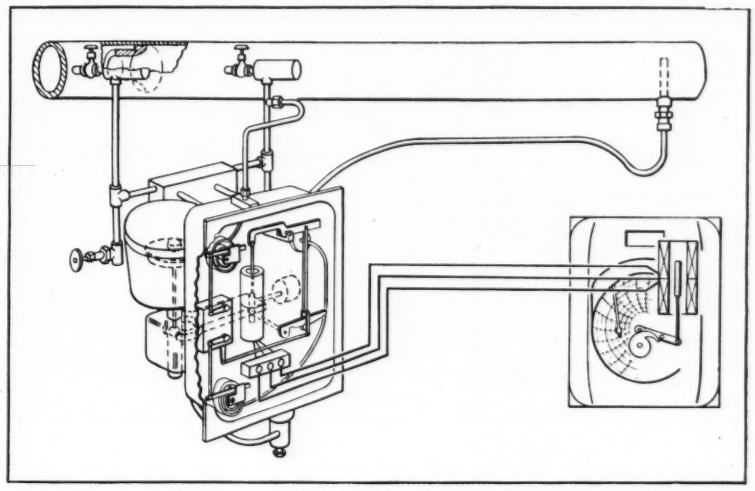


Fig. 50. Differential reading is corrected for pressure and temperature, and transmitted as well as recorded.

use by the consuming system exceeds the controlled rate the pressure will drop. The transmitter will compensate for this change so that the control will be on a true flow rate. It is evident that this system requires a large totalizing meter run similar to that in *Fig. 46*.

Pressure compensated flow as used in *Fig. 48* is obtained without the necessity for the large totalizing meter run.

Under normal flow conditions the system is on pressure control from the PC with the valve springs set for staggered operation. The 3-way valve is in position to allow the control air of the PC to go to the diaphragms.

A differential limit control operates the trip valve to bring in the second meter run upon increase in flow. A differential transmitter on the secondary run and a pressure transmitter operate the metric poly-pneumatic or similar instrument. This instrument multiplies the two air inputs and controls upon the basis of the product. The transmitters are designed to have a square root output so that the poly-pneumatic controls flow. The control air of this instrument goes to the third port of the 3-way valve. It also operates a snap-acting air switch at a predetermined point. This trip switch operates the 3-way valve to cut in the poly-pneumatic at a given flow rate. The control then acts to limit the true flow rate. The operation of this system may not be without bumps but the capacities of most distribution systems are large enough to absorb the change.

Pressure control and flow limiting are accomplished by using the controlled air output of the flow controller as the supply for the pressure controller *(Fig. 49)*.

Philadelphia Gear Works Inc.

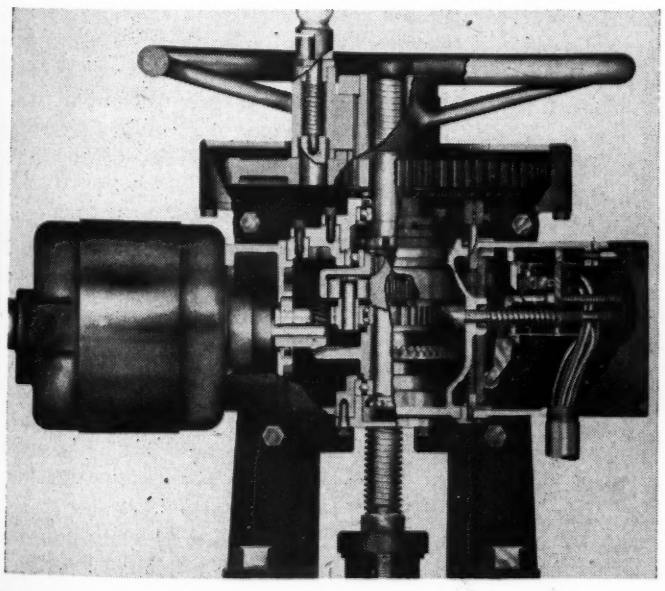
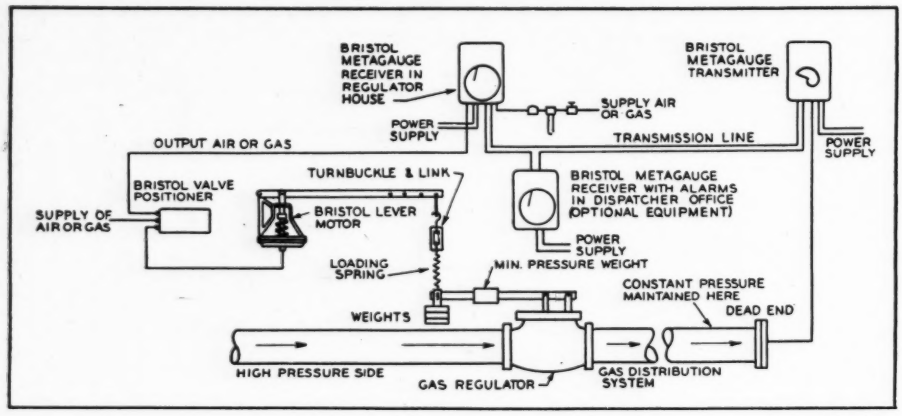


Fig. 51. Electric actuator for large valves may be positioned accurately by a controller or manually by the dispatcher's office using a bridge circuit.

During normal operation the diaphragm-motor valves are actuated by the pressure controller. The valve springs are set so that the valves are not opened simultaneously. The valves are normally open or open on loss of air. To accomplish the desired operation, the PC is reverse-acting and a reversing relay is placed in the controlled-air line. Thus an increase in pressure causes the output of the controller to drop. This will increase the pressure to the valve diaphragm through the reversing relay to close the valve. The supply air of the pressure controller is the controlled air of the flow controller. The FC should have automatic reset so that the output will be sufficient to set the valves rather than merely being relative to the set point. Thus the output of the FC will be 15 lbs at any flow less than the set point.

The set point of the FC will be at a high rate of flow so the diaphragm-motor valves will be pretty well open to hold up the pressure. Thus the output of the PC will be high, a condition obtained by positioning the flapper close to the nozzle. As the flow rate passes the set point, the controlled air of the FC will decrease. This pressure will pass through the PC to close the valves. This will decrease the pressure and further guarantee the bypassing of the PC. The output of the FC will continue to drop until the flow rate is at the set point.

It is understood that at low flow rates not requiring control limiting, only one meter run is in operation. Upon reaching the capacity of this run, the differential trip controller actuates the valve in the second run. This places the FC in operation. The control point of the FC is set upon the assumption that the load is about equal through each run. De-



Bristol Co.

Fig. 52. Telemetric system used to reset the loading of a regulator. Reset may be by dispatcher instead of by deadend pressure.

pending upon company policy, the flow control mechanism may be included in the flow meter on the secondary tube. Telemetering may be done off the primary tube, necessitating doubling the reading when two tubes are in operation.

This system does not attempt to control the square root of horsepower, or flow, but rather controls differential. Appreciable static pressure effects will decrease the flow below the desired set volume. The use of a pressure-compensated FC would overcome this deviation.

DISPATCHER OPERATIONS

Remote transmission, whether pneumatic or telemetric, is of greatest value in a system containing more than one city gate station, or in cases where wide variations in gas consumption require rapid and frequent changes in pressure. To accomplish the necessary operational changes, the dispatcher must have a record of pressure on the transmission line, reduced pressure in the station, flow as shown by differential pressure, and ideally, the position of valves. The dispatcher would much rather have a reading of true flow ($C\sqrt{Ph}$), but in most installations this is not being achieved. A reading of differential, to which a pressure and/or temperature correction has been made, is being accomplished by differential recorder suppliers.

One means of obtaining this is shown in *Fig. 50.* When this instrument is used, the normal operating pressure is used in calculating the coefficient. This system is not being used for measurement for gas billing. The output of a pressure transmitter and differential transmitter may be multiplied together by the use of a Poly-Pneumatic Controller* or similar instrument, to give an output proportional to their product. The square root may be extracted at the transmitter. In stations using two or more meter runs, each meter run must have a telemeter or, based upon the assumption that there is equal or proportional flow through the various runs, a factor applied to the telemetered value to reflect the additional tubes cut in. Various readings may be combined electrically. Each telemetric transmitter positions a slidewire so that output of these potentiometers may be totaled and transmitted as the reading of an ammeter. The receiver may be calibrated for total differential reading.

For the dispatcher to use his telemetered information to advantage, equipment must be available for the dispatcher to make changes in the station operation. Throughout this discussion a general assumption has been made that the city gate station is complimented by distribution control stations within the area using the gas. Although this is not always true, it will be true that in most city gate stations the necessity for changes in operation will be fewer than at a distribution control point.

If the station does metering only, the dispatcher should be able to operate a valve to increase or decrease the flow through the station. In this manner he would supply sufficient volume and consequently sufficient pressure to make the distribution regulators operate properly. The remote valve readily may be positioned if the transmission system is pneumatic. Piston- or diaphragm-actuated valves assume a position in direct ratio to the loading pressure so the changes may be made on the dispatcher's panel using a loading regulator *(Fig. 40)* which will increase or decrease the pressure without the disadvantage of a constant bleed. More rapid operation may be obtained by using the 1-to-1 relay *(Fig. 37)* at the valve. The change in flow obtained is noted on the flow recorders. Valves in this service, of necessity, become large. It becomes wise to use some type of actuator of the type reviewed in October *GAS* on page 74 adaptable to large valves and cocks. The use of the reversing pneumatic relay makes it possible to position a piston or gas-motor actuator by increasing or decreasing the transmitted pressure.

Electrical operation of valves from not too remote locations is accomplished by one of many accepted approaches. These methods require three or more wires for reversing, or multi-wire selsyn circuits. Wide use has been made of a circuit *(Fig. 33)* to polarize an alternating current so that the position half cycle is used to operate a relay for one function while the negative portion is used for another function. This circuit has been adapted to a telemetric system† in such a way as to change the position of a valve or controller incrementally through a short time period and then return to the telemetering of the variable that has been changed so the amount of change may be noted.

An interesting circuit has been developed which can be adapted to electrically operated actuators of the type shown in *Fig. 51,* to make more radical changes of position. The circuit would be operated remotely, positioning a slidewire to any position with a reversible motor and allowing the bridge circuit to sense the setting of the valve opening as shown by another slidewire. The reversing circuit may be used in conjunction with solenoids to operate gas or air-motor actuators. The subject of remote control is such an extensive and vital one that each new installation brings advanced application of existing equipment or development of new instruments for the solution. A selected number of fine articles and books on the subject is listed in the bibliography.

Variations of combinations of transmitting methods and control mechanisms are numerous. A few possibilities are as follows:

1. Pneumatic loading of reset bellows of a controller.
2. Pneumatic loading of control section of stack controller *(Fig. 42).*
3. Direct pneumatic loading of valve using diaphragm or reversing relay with valve positioner.

*American Meter Co.

†by William LaViollette, Pacific Gas & Electric Co. San Francisco.

4. Telemeter to incrementally jog valve open or closed.

5. Telemeter to change output of pneumatic transmitter which is the telemetric receiver.

6. Telemeter to set loading of a weight-loaded regulator *(Fig. 52)*.

Variations in the use of these tools make it possible to give a dispatcher, whether in a plant close by or at an office hundreds of miles away, the ability to make any changes in operation which it might seem necessary to include in the design.

CHARACTERISTICS OF THE GAS

Years ago (and possibly at present in isolated cases), the day-to-day measurement of gas merely required a recording of differential across an orifice and the static pressure on the line. Periodically, usually once a month, a sample of the gas was collected in a bomb from which the specific gravity was determined on a gravity balance. The temperature of the gas, likely as not, was obtained by averaging three readings of a glass thermometer in the line, taken over a 24-hour period. Very often a monthly average taken from a recorder on one particular buried line in the vicinity was used. Before about 1935, no correction was made for deviation from Boyle's Law. For many years since then, the result of tests on a typical natural gas has been satisfactory for other natural gases.

Application of correction factors for the variables in the manner mentioned may be satisfactory in many cases, but are not satisfactory when the transfer of hundreds of millions of cubic feet of gas a day at elevated pressure is made through a single meter setup. The degree of refinement needed to determine the values of each of these variables at a city gate station should depend upon the availability of the desired information at another station close enough to give representative results, the possibility of variation from periodic test readings, and the reliability of results of tests furnished by a transmission company for the use of a consumer.

Pressure

Although many chemical plant and steam plant operators attempt to simplify steam, gas, or vapor measurement by assuming that a line pressure will be constant enough to include the static pressure in the meter coefficient, the gas measurement engineer does not do this.

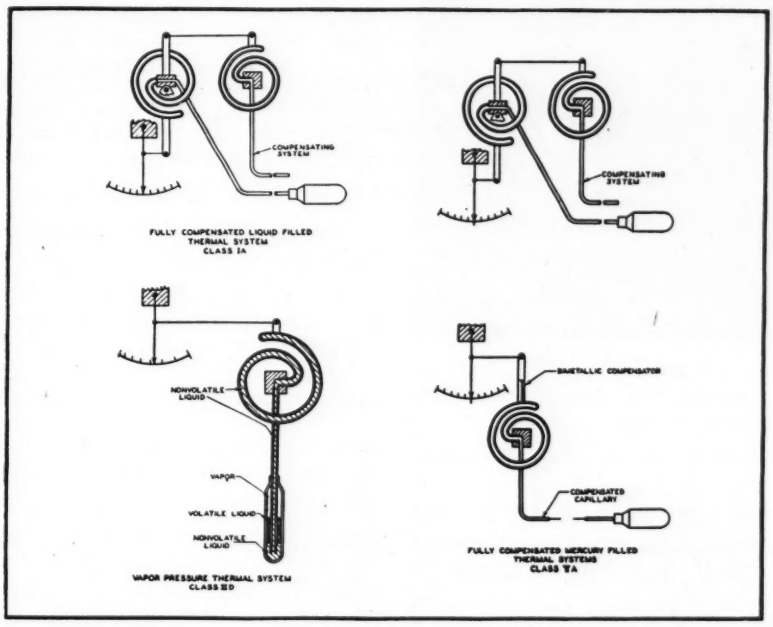


Fig. 53. Methods of compensating thermal elements for ambient temperatures.

He keeps constant watch on the static pressure on the line even when the meter runs follow the best of control equipment. Operating conditions require pressure changes which necessitate a reliable record of pressure throughout the day.

Reliability of the element used to record pressure for use in calculating gas flow is quite different from the requirement for control purposes. Selection of a control setting is a very arbitrary thing which needs only reproduction after upsets have occurred. Correct calculation of gas flow requires reproduction of an initial calibration which can be compared to another instrument.

The elements that we use for pressure measurement, namely, metallic bourdon or spiral coils, seem to be, according to reports, among the least accurate of our present-day measuring means. The use of dead weights as a standard seems to be much more reliable. Test data point toward the use of strain gauges as being superior to bourdon or spiral coils. The elements in use are infinitely easier to work with and not susceptible to damage in rough handling. Ability to calibrate frequently has been made possible by the use of inexpensive, portable dead weight testers which may be installed in the station when warranted.

Although elements are available for measuring absolute pressure which is required in the gas flow formula, the range is not high enough to be used on most pipelines. A pressure gauge may be calibrated to add the average barometric pressure to the gauge reading. This does not seem to be the general practice for city gate stations as the absolute pressure used for chart calculation is the gauge pressure plus the contractural pressure base. Some companies use the barometric pressure by zones as stated by CNGA.* The gauge is calibrated for the correct valve for the elevation at the location of the meter.

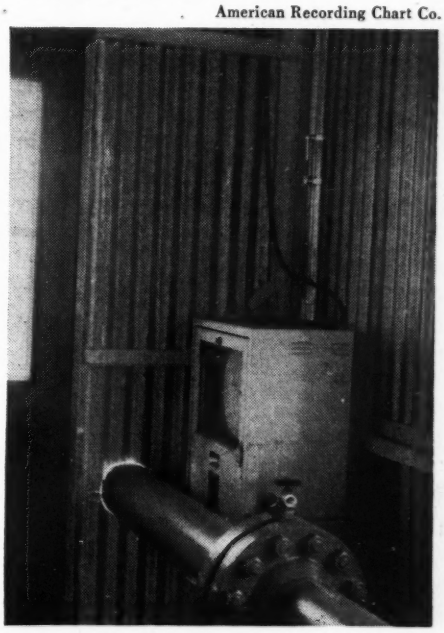
Temperature

Temperature of flowing gas must be determined. In most cases the average of the three readings taken over a 24-hour period is not deemed sufficient. A

*California Natural Gasoline Assn.

Fig. 54. Gravitometer may be installed at the meter station.

American Recording Chart Co.



Cutler-Hammer Inc.

Fig. 55. Installation of calorimeters for use at a city gate station.

continuous 24-hour recording is used. The changes in gas temperature coming into a station from a gas transmission line are very slow, much slower and less radical than changes in ambient temperatures. This simplifies the selection of the recorder system and bulb assembly. All of the classes of filled thermal systems may be used, although it is advisable to use a fully compensated system to correct for the changes in weather when a capillary tube longer than a few feet is necessary. Methods of compensation are shown in *Fig. 53.* A thermal system giving a uniform indication is used generally because it is unnecessary to take advantage of an expanded portion of the chart which is used to obtain accurate control. The temperature recording may be incorporated with some other single pen instrument. This will usually necessitate the use of dual scale chart.

Rapid response could best be obtained by the insertion of a bare bulb in the gas stream. High pressures, high velocities, and slight possibility of impurities make it advisable to use thermowells. Thermowells are installed in the downstream section of each meter run. The bulb of the instrument is inserted into the primary tube which is the tube in constant use. Sufficient capillary should be provided to insert the bulb in any other tube in case the first tube is cut out. A check well should be installed close to this first well so that the recorder may be checked while in use with a glass or industrial thermometer.

Many different lengths for bulb insertion have been recommended but the following has been found satisfactory. The thermowell length is the length from the end of the well to the first thread. This is a manufacturer's dimension and is suitable assuming the use of a Weldolet or half coupling as the pipe fitting.

Size of Line	Length of Thermowell
3	3
4	4½
6	6
8	8
10	8
12 or longer	12

Although many process design installation specifications call for inserting a thermowell in an ell or tee with the well butting into the stream, this is not general practice for city gate stations.

Specific gravity

Some acceptable value of specific gravity must be available for use in the volume calculation employing an orifice meter. A variety of elements enter into the determination of how to obtain this value. The methods vary from the periodic taking of a single sample to the continuous recording by an instrument in the station. This specific gravity value is only necessary for volume calculation. The gas contract does not set gravity limits; rather, it stipulates heat content of the city gate station which is relative to the percentage of various constituents in the gas, which in turn determines the specific gravity. The specific gravity of gas being delivered to a city gate station may vary considerably when the transmission line is handling gas from a limited area. In this case, the curtailing of one or more large wells can cause a perceptible change. Change in the gasoline content of the gas being discharged into the transmission line would make additional change in specific gravity. On the other hand, the combining of gases from any fields and continual compression and cooling will minimize these changes in gas being delivered at distant points.

Choice of a procedure for obtaining specific gravity would seem to lie between the following possibilities:

1. *Taking a sample of the gas.* This can be done in a bomb over a long period or over a short period just sufficient for purging or displacing the water in the bomb. The sample would be run on the gas laboratory equipment which may be a balance or a test gravitometer.

2. *Making on-location test.* A portable gravitometer, balance, or Schilling bottle may be used at the station for readings.

3. *Using district specific gravity charts.* The results of charts obtained at a compressor station or terminal point will represent the characteristic of gas used within the area supplied by this unit.

4. *Installing a recorder in city gate station.* The standard kinetic or balanced type recorder may be installed as shown in *Fig. 54.*

Literature explaining gravimetric instruments and their installation is available from handbooks and the limited number of suppliers of the equipment.*

Heat content

Heat content is basically the most important characteristic of gas which is to be used for fuel. The chemical composition of natural gas is such that operators have come to expect to obtain between 1000 and 1100 Btu from 1 cu ft of gas. Gas contracts may be based upon a minimum heat content, price adjustment for variation from 1000 Btu, or a range from minimum to maximum. In any event the parties to the contract are interested in knowing the value over the entire period of use of the gas.

Use of the recording gas calorimeter shown in *Fig. 55* has become standard in the industry. The same approach to determining the necessity for a calorimeter in a city gate station is similar to the approach used for the gravitometer. The decision becomes more important because of the cost of the calorimeter and the stringent requirements of its installation. The calorimeter is affected by vibration, has an open flame precluding installation in the vicinity of regulators and meters (both because of danger of explosion and because even traces of combustibles in the surrounding air cause erroneous readings), and requires relatively constant ambient temperatures. These conditions would indicate that an isolated room be set up for the instrument.

It may not be necessary to duplicate a calorimeter installation in any area where the gas has become stabilized by supply from numerous sources and repetitive processing.

Supercompressibility

C. M. Carter of Texas Gas Transmission Co. makes a very pat statement** of supercompressibility when he observes, "When you empty a container filled with natural gas under pressure, you will find that the amount of gas you take out of the container is greater than the law stated was in there." Equipment has been designed by E. S. Burnett of the Bureau of Mines and H. S. Bean of the Bureau of Standards to determine this deviation from Boyle's Law. The deviation also may be determined by evalu-

*American Recording Chart Co., American Meter Co., and Permutit Co.

**At the 1950 Southwest Gas Measurement Short Course, Norman, Okla.

ating the deviation of the components of the gas as shown by a fractional distillation.* Many companies have calculated or obtained from test enough values of supercompressibility for the gas that they are distributing to make it possible to use readily measured variables for a given meter-run installation to plot Reynolds number - supercompressibility (Fr Y) factors. Very few city gate station installations warrant individual determinations at the station.

Moisture and dust

Standard gas contracts usually contain the statement that the gas shall be commercially free from objectionable odors, dust, or other solid or liquid matter which might interfere with its salability or cause injury to or interference with proper operation of equipment. Instruments for continuously testing for dust or moisture are not used, but equipment to remove dust or moisture is often essential.

A common phenomenon is evidence of excessive moisture for a period after a new line has been put into service followed by dust after the line has dried out. A periodic inspection of the orifice plate will show evidence of excessive dust. The transmission company is committed only to supply "dry" gas (essentially methane) so plants are usually installed to extract all other marketable products. In doing this they furnish a gas that in reality is dry from the standpoint of moisture as well as of hydrocarbon content. This dry gas will absorb extraneous water and oil left in the line. The fact that natural gas is so dry causes maintenance problems in existing systems.

Instruments are available for continuously reading water vapor dew point of gas but are not in common use in city gate stations.

PREPARATION FOR DISTRIBUTION

Scrubbers

Removal of liquid from gas is accomplished by impingement, reversal of direction, and expansion. The simplest design of a scrubber *(Fig. 56)* embodies these factors. Gas entering the scrubber bumps into the plate which tends to knock out moisture and agglomerate finely divided drops. The change in direction required to flow around the plate allows moisture particles to drop out. The momentary expansion caused by the relative areas in the scrubber assists in dropping out moisture.

Removal of dust or solid foreign matter is more often the problem—at least in stations separated from the gas field by compressor stations and extraction plants. Dry type equipment has been designed for efficient removal of coarse dust and this type is surely the simplest and most economical to maintain. Finely divided dust or rust are difficult to remove so the surest way is to scrub the gas. Again there are about as many designs of wet and dry scrubbers as there are gas engineers, but it is safe to say that from among the thoughtfully designed commercially available units it is possible to select one that incorporates the method desired at a price lower than for the custom built unit.

Whether or not to incorporate a scrubber is a decision which confronts the designer at each station. The cost warrants serious consideration of the possibility of trouble due to dust or liquid. It is always advisable to install stubs on each side of the inlet shutoff valve for future trap installation. These stubs may either be blinded or include valves, depending upon the difficulty of shutting down the line so as to install the valves and scrubber at some future date.

Line gas is being used at most smaller city gate stations for operation of the instruments. The quality of gas for this use is much more critical than for other uses. Instruments require gas at approximately 20 psig. It is advisable to use a primary regulator in addition to the regulator at each instrument or group of instruments if the line pressure is greater than 150 psig. Use of a filter with a felt, porous-stone, or some similar filler installed after the primary reduction, takes advantage of a psychometric change as well as slight cooling to assist in dropping out moisture. Many companies use a small glycol chamber to insure against moisture which would foul the controllers. Use of gas instead of air as a control medium requires consideration of venting of the controller and precludes the use of an electric chart drive. This is not a handicap as the standard spring drive may be used. Both gas-driven and explosion-proof electric drives are available.

Chemical impurities

Evidence of nitrogen or other noncombustible diluents is not usually covered in a gas contract. The guide is heat content, which could not be held to contractual requirements if the percentage of these elements became too high.

States into which natural gas is being piped are now conscious of the benefits of the gas as well as the precautions necessary for its safe use. This knowledge has led to legislation limiting the allowable hydrogen sulfide and total sulfur content of the gas. Control of this characteristic of gas is accomplished by periodic tests and requires only a sampling point in the city gate station.

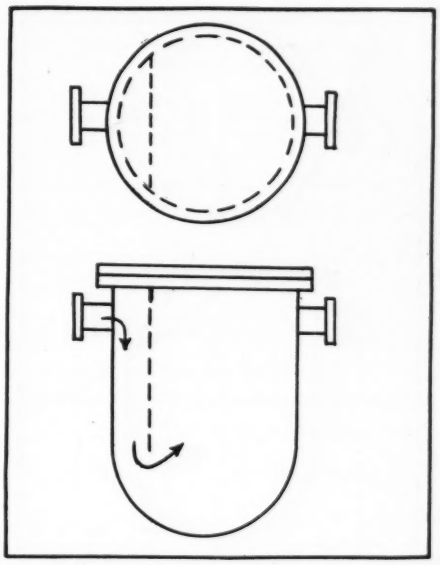


Fig. 56. Design of simplest scrubber includes change of direction, expansion, and impingement.

Combustible gas indicators

Recorders and alarms to detect a dangerous atmosphere are not used generally in city gate stations. A portable instrument is used to check an area in which welding must be done. Some large stations which combine an office, calorimeter room, and shop with metering and regulating equipment do install an alarm system. This is usually the type of system which monitors individual cells at various locations, although a blower may be used in conjunction with a rotary selector valve to bring samples from various locations into one cell. Many alternate uses for the indication of the existence of a combustible atmosphere are possible, such as starting a ventilating fan, opening louvers, or giving a local or transmitted alarm.

Gas hydrates

Hydrates are ice-like deposits which can plug regulators, orifice meter tubes, etc. Their formation and composition have been the subjects of much study and discussion. The city gate station de-

*This method is covered by CNGA Bulletins TS 354 and TS 461.

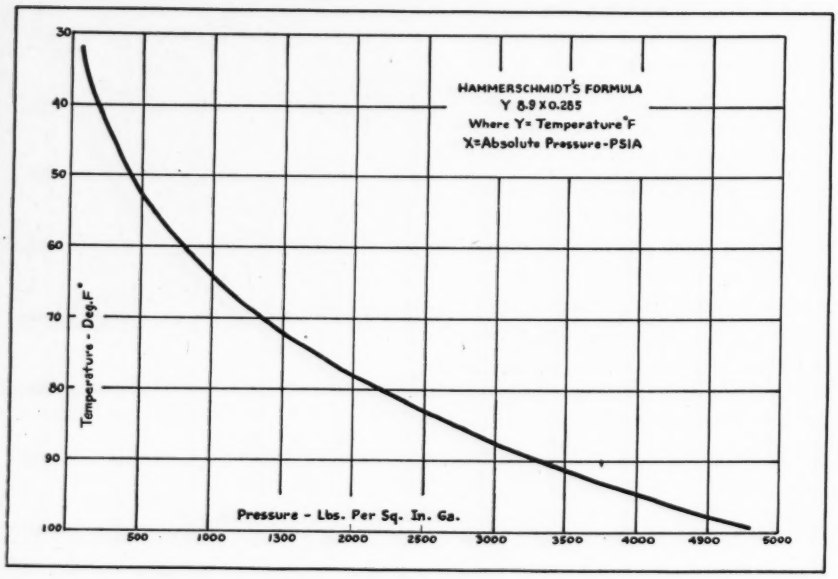
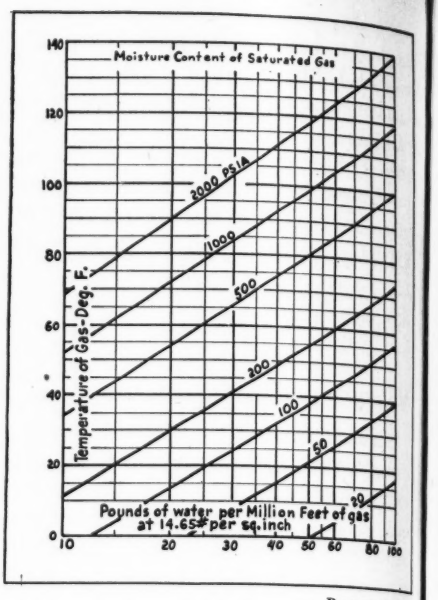


Fig. 57. Temperature and pressure relationship which is sympathetic to hydrate formation.



Bureau of Mines

Fig. 58. Moisture content of saturated gas.

signer is interested in eliminating, as far as possible, conditions which are conducive to hydrate formation and making provisions for continuous operation if hydrates do form. The formation of gas hydrates requires three conditions. First, the pressure and temperature conditions must favor hydrate formation (see *Fig. 57*). Second, water must be present in the liquid phase. Third, the gas and water must be thoroughly mixed. The problem resolves itself into the question, How is it possible to determine when these conditions may exist in a city gate station, and what can be done to prevent the satisfying of any one of these conditions so that hydrates cannot form?

Existence of a pressure-temperature condition falling below the curve *(Fig. 57)* is very possible, particularly following a large pressure reduction. M. A. Hardie* gives some very useful approximations of the effect of pressure drop through various types of plugs and seats. Mr. Hardie lists the conditions shown in *Table 1.*

*In a paper presented at the 1950 Southwestern Gas Measurement short course.

From the data, it is evident that a 240-lb drop through a V-port valve, from 440 psig to 200, for example, with a resultant 20° F drop could cause a gas at 60° F, which is well above the curve, to become a gas at 40° F, which is the critical point for hydrate formation at 200 psig.

Fortunately, water in the liquid phase must be present to cause hydrate formation. Reference to the curves in *Fig. 58* will show the amount of water in saturated natural gas at various pressures and temperatures. Again it is fortunate that the transmission companies, by processing and repetitive compression, are removing water so that it is unlikely that the gas received at a city gate station will contain more than 10 lbs per MMcf, under normal operating conditions. Abnormal conditions may exist for an extended period after a new line is installed. It is during this period that protection may be required.

Thorough mixing of the gas and free water is accomplished by passage through even the most completely streamlined plug, so it is usually assumed that if the first two conditions sympathetic to hydrate formation exist, the third is also present. Assuming the possibility of hydrate trouble, it is necessary to determine the equipment required to change the temperature and pressure conditions so that trouble will not occur.

Six methods present themselves for the prevention or disposal of hydrates:

1. Reduction of pressure may be accomplished in steps at locations far enough apart to obtain warming of the gas between the regulators. In most cases this is not practicable, but it might be used in a system where a pressure reduction is made close to the transmission line and another reduction made at a point where the gas enters a distribution system. It has become evident that hydrate formation is most likely to occur within the regulator when the flow rate is low, while high flow rates cause trouble in or around the piping, external to the regulator. This step reduction of pressure will help in eliminating either of these conditions.

2. Heating of the gas stream, or the equipment that is susceptible to plugging, is sometimes resorted to. Well designed hot-air or liquid heat exchange equipment is available, and both are being used extensively to heat gas from wells or at locations where the gas has not been processed. The decision to use a heater must be based upon careful consideration of the other, less expensive methods.

3. Insulation of equipment aboveground may be sufficient. This approach will be adequate if the hydrate condition is expected to occur for short periods of sufficiently low ambient temperatures. In many areas the chill of the night is not sustained sufficiently to make any change in the ground temperature. High quality insulation will maintain the gas and equipment

TABLE 1.

Type of Plug and Seat	Pressure Drop to Cause 1° Decrease in Temperature
Balanced wing guided quick opening	10
Top and bottom guided V port	12
Top and bottom guided parabolic	15
Single seated angle valve	16
Single-seated streamlined plug	18

at ground temperature during the chill period.

4. Adequate dehydration will prevent hydrate formation. This is often done as a contract requirement before the gas arrives at the city gate station.

5. Reference to the table showing the effect of various valve designs upon temperature depression shows that the selection of a regulator style, such as the single-seated streamlined plug could make enough difference in the temperature-pressure relationships to prevent hydrate formation. Any streamlined design of piping in the station which decreases turbulence reduces the possibility of hydrate trouble even though the extent cannot be evaluated.

6. Addition of certain chemicals will inhibit the formation and remove restrictions already formed. The use of alcohol (methanol) has found wide acceptance, although ammonia has been used with success by numerous companies. Other chemicals such as acetone, ammonium carbonate, N-propanol, and ethanol have been studied but not used extensively. The difficulty in the use of methanol or other substances as inhibitors arises in determining when the moisture content of the gas will become troublesome and what the moisture content will be at that time. For this reason methanol is usually added in greater quantities than is necessary and at times when it is not needed; or a freeze occurs and the methanol is slugged excessively.

Most equipment for injection consists of an elevated tank made of pipe. An equalizer line is run to the vapor space so that the head of liquid is utilized to move the methanol through a needle valve into the line. It is advisable when designing a station to install a nipple and cock at some point ahead of each regulator for methanol injection. Location of the injection point on the outside periphery of an ell causes good mixing of the liquid with the gas. An instrument is on test which senses the approach of conditions sympathetic to hydrate formation and at that time starts methanol injection, stopping the liquid flow when the necessity does not exist.

Mention has been made that under certain conditions the cooling effect occurs at some point beyond the regulators. In most stations the next obstruction is the orifice plate. Preventive measures are always best, but if formation does occur, it would be well to have an easy means of withdrawing the orifice plate. The orifice fitting will accomplish this.

Throughout this study numerous possible approaches to a particular problem have been mentioned. Many pieces of equipment have been depicted, but this is by no means intended to imply that a piece of commercially available equipment offered by a particular supplier is the only equipment, or the best, available. Effort has been made to picture equipment that has been accepted by industry (although not always the gas industry). Under some circumstances a recommendation has been made, but for some unorthodox application rather than for a particular supplier. Gas pipeline design engineers are fortunate to have so much good equipment at their disposal. Cooperation between designers, operators, and manufacturers advances the development of new devices and the improvement of existing ones. Appreciation must be expressed for the cooperation of operating men and suppliers for furnishing information and material for this article.

THE AUTHOR'S PET DESIGN FOR A STATION

(Several of the illustrations in this section are repeated from the first installment printed last month. For this reason they retain the same figure numbers used in that installment.)

To conclude this summary of the factors involved in the city gate station design, a hypothetical station based on the layout in *Fig. 22* will be developed for the benefit of the axe throwers. (Do not think that the axe thrower is being belittled, as this pastime, assuming the use of a keen axe and not a blackjack, creates healthy discussion.) In this hypothetical station no elaborate instrumentation is used and no facilities for scrubbing the gas have been provided.

Every effort is made to eliminate radical changes in direction for the elimination of noise. The elevation of the control valves and meter runs is obtained by using 45° bends. A header with a dead end has been eliminated. It might be advisable to use the end meter run as the primary so that the flow of gas would be around the long radius bend during a greater part of the station operation. This would, however, place the trip valve somewhat in the way in the small meter house.

The inlet line is small with the valves ahead of the control valves the same size as the control valves. In most cases this can be done because pressure drop is not a concern at this point. The size of the lines following the control valves is increased with the so-called header the same size as the largest meter run. Valves

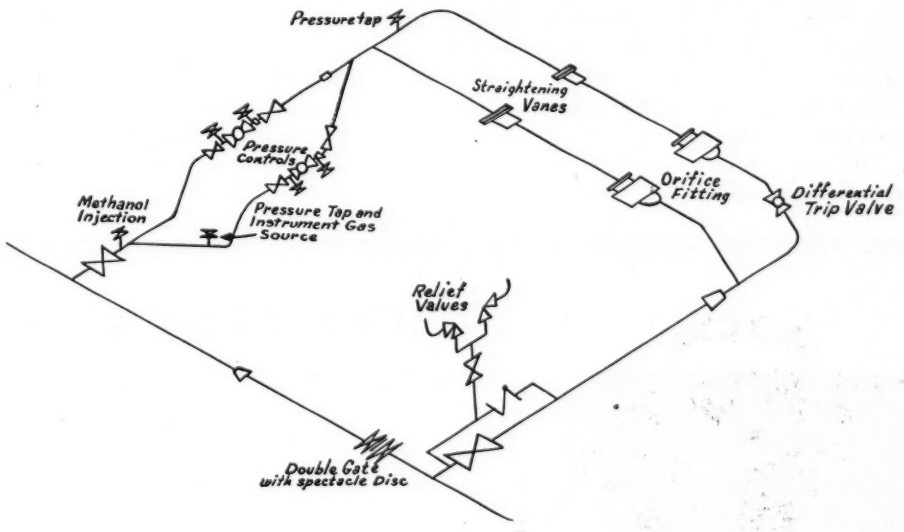


Fig. 22. The author's pet design for a small city gate station.

and fittings, up to and including the valves following the control valves, must be rated for the maximum line pressure to be expected. This is necessary because the piping at this point is not protected by relief valves. A small valve should be provided ahead of each control valve for methanol injection if and when this may become necessary.

The length of the meter runs should be sufficient for an increase of one pipe size. This increase will require swaging to the increased size. Sufficient room should be left for an increase of one size in the control valves.

Additional meter run

No provision has been made for the addition of another meter run as this may be accomplished by shutting down the station to do the required welding. Straightening vanes are used both for economy in the size of the station and to preclude inevitable arguments. The flange type is used to allow for removal of the approach section of the meter run. This design requires the use of the orifice fitting, which allows for inspection of the plate without taking the run out of service. The orifice fitting is welded to the approach section and flanged to the discharge section. The discharge section may be removed between this flange and the flange of the trip valve or, in the primary run, the flange in the diagonal riser. The flange is placed at this point so that no change is necessary if the meter run is enlarged. All fittings within the station are rated for the set point of the relief valves. Present practice seems to require that the orifice fitting be installed on its side. This is done to place the static taps on the top to conform with recommendations for gas measurement. Less space is required with the fittings in an upright position and the results will be comparable using clean-dry gas.

The bypass may include an orifice plate as the spectacle plate of a twin gate valve *(Fig. 24)*. Pressure control during shutdown period must be accomplished at another valve which may be where the lateral ties into the transmission line. Flexibility is obtained best by using an orifice plate installed between flanges, and pressure control can be obtained with a plug cock equipped with a gear operator. A meter run ahead of the bypass cock may be smaller than if it were on the low pressure side. When the measurement is on the high side the static pressure spring of the meter must be of suitable range.

The relief valves are shown piped to protect the station and the consumer's line. This is one approach to the dilemma mentioned in the article. This system places a great deal of faith in the check valve so extreme care must be used in its selection. The assumption is that when the station is on the line it does not matter if there is flow through the relief valve piping. When the station is off the line there is no gas to open the check valve so it closes with the pressure in the line from the station.

Instrument panel

Recorders of differential pressure, static pressure, and temperature, as well as pressure controllers, are placed on an instrument panel in a small house. The house is constructed of prefabricated steel unless conditions of the installation dictate some other approach. The static pressure pen is installed in one differential recorder and the temperature pen is installed in the other. It may be desirable to use a two-pen pressure recorder to include the pressure ahead of the control valves. The differential trip control usually appears on the board, although it offers no information. This instrument could just as well be a non-indicating

For complete specifications write for Bulletin 50.

ACCURATE GAS PRESSURE

The RS Standard Dead Weight Gage facilitates testing gas pressures; rock pressure at wells; static pressure on orifice meters and pipe line pressure in locating leaks. The design of the gage is based on the principle of applying pressure by a known weight to a hydraulic piston of known area; and of the converse effect to measure unknown pressure by balancing its force on a piston of known area with a known weight.

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device or mounted flush in a small case. Instrument piping consists of steel tubing supported as shown in *Fig. 13*. A pressure controller is provided for each control valve. The pressure controllers are mounted on the control board in the event there is vibration on the line.

Telemetering equipment may be added to this installation without changing the size of the house as the transmitters would be placed in individual meter houses similar to *Fig. 1*. The differential connections for telemetering are usually taken from the taps on the side of the orifice fitting opposite from the taps used for the billing meter. This accentuates the advisability of placing the orifice fitting in an upright position.

This station would be lighted by a flood light on a pole and a light inside the house. The button would be located at the gate. A utility plug would be installed on the outside of the house to be used for tools and a portable flood light for use when working on a piece of equipment in the station yard.

CONCLUSIONS AND BIBLIOGRAPHY

Agreement with the approaches to the various problems of city gate station design is not invited. A summary of the problems is, of necessity, abridged as each phase has been the subject of innumerable papers and discussions. The summary is presented as a guide to the factors to be considered with the hope that the article may be used by some who are confronted with the task of designing a station and by others as a basis for needling the design engineering companies to employ advanced and possibly unorthodox approaches. There are many throughout the gas industry, both in the operating companies and among the engineers of equipment manufacturers, who are thinking of the future. Their work and thought is necessary so that the city gate station of the future may be constructed completely to satisfy the conditions for which it is installed.

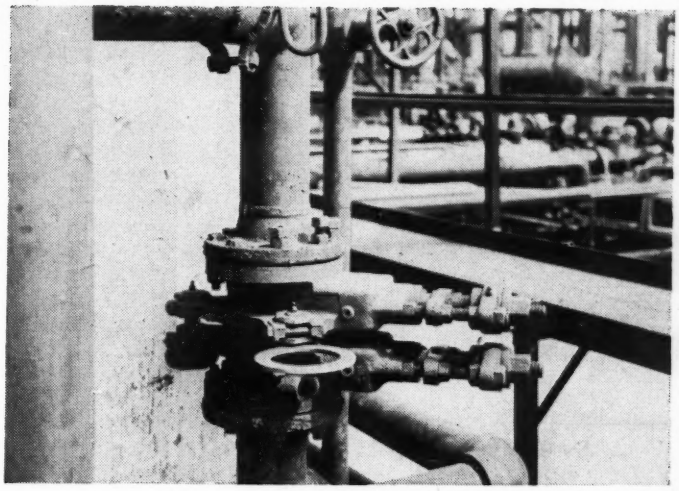

Fig. 24. The bypass may include an orifice plate as the spectacle plate of a twin gate valve.

Hamer Oil Tool Co.

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Single Control Room Integrates Entire System, John J. Crilly, October 1952.

Valve Positioners, C. S. Beard, April, May 1952.

Working Method For Predicting Supercompressibility Factors, Richard H. Zimmerman and Samuel R. Beitler, October 1952.

Other articles to which reference is made:

Better Utilization of Metallic Circuits In Remote Control and Telemetering, William A. LaViolette.

Determination and Application of Supercompressibility Factors, C. M. Carter.

Medium and High Pressure Regulator Settings, W. P. Dick.

Control Valves and Regulators, C. S. Beard.

New Gas Odorizer Buildings At Memphis, W. A. Dunkley.

Fig. 13. Instrument piping in this installation consists of steel tubing supported as shown.

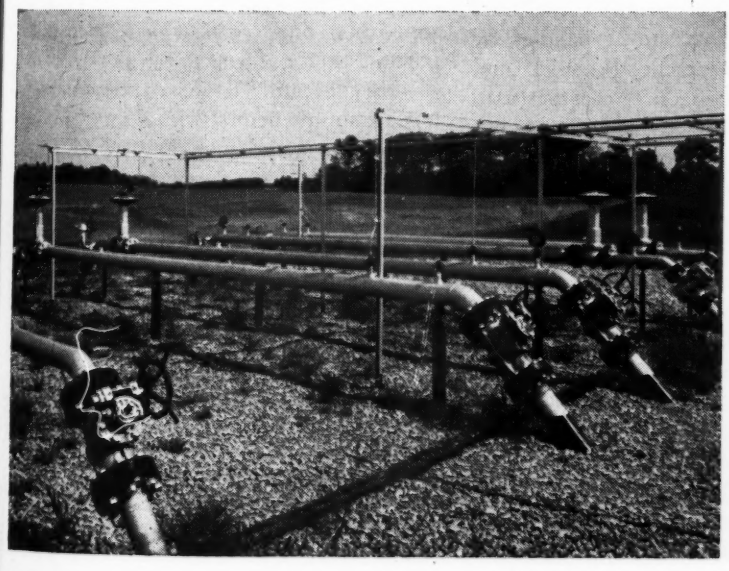
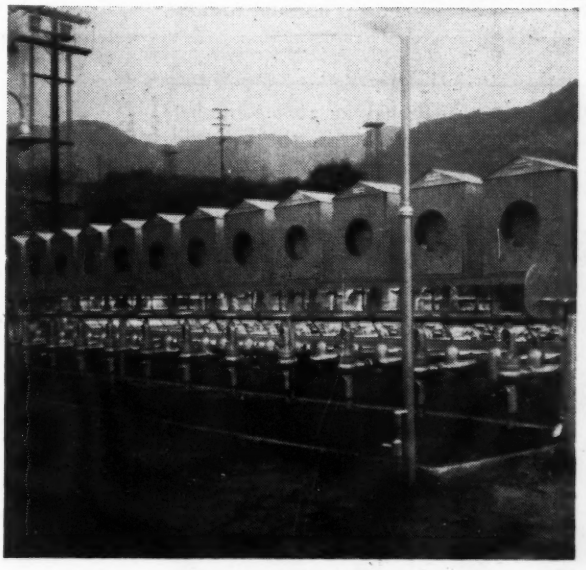


Fig. 1. Individual meter houses may incorporate telemetering equipment.

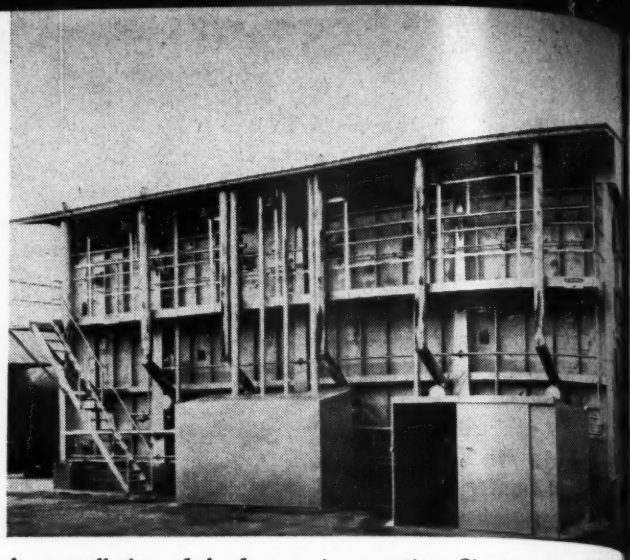
Gordon Z. Greene Co.



GAS exclusive

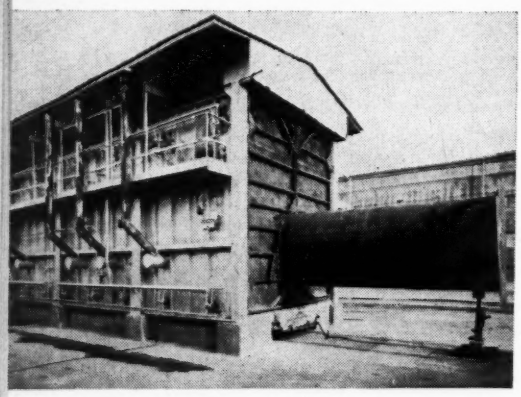
A low-cost stress relieving furnace

By FRED M. BURT



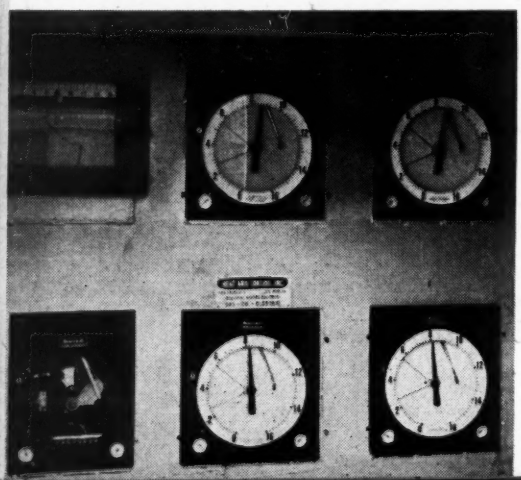
An overall view of the furnace in operation. Closed swing doors at right, instrument enclosure in right foreground, and blower enclosure in left foreground. (Fig. 1.)

A VERY effective stress relieving furnace at the plant of Southwest Welding & Manufacturing Co., Richmond, Calif., was inexpensively erected, using an existing spur track and an old knock-down type field stress relieving furnace as the basis of the structure. General foundation and structural design was furnished by the engineering department.



Special split swing doors with long penstock section extending outside furnace. (Fig. 2.)

The control panel has four zone controllers with set points actuated by the cam-type program controller. Multipoint recorder is in upper left. (Fig. 3.)



The redesign of the unit, together with supplementary burner and accessory equipment required, and the automatic temperature control application, were furnished by Heat & Control Inc. of San Francisco.

The knockdown field unit was only a 22-ft cube furnace, so it was supplemented with additional panel sections and supporting structure. The new furnace, 46 ft long, 14 ft wide and 16 ft high (car deck to roof), was designed to incorporate the old furnace panels with a minimum of alteration. Service temperatures are limited by the nature of the lining to stress-relieving ranges up to 1250° to 1300° maximum. This relatively low temperature range permits the use of inexpensive, split swing doors *(Fig. 1)*.

Spare doors are available with circular openings for loads that have to project out through the end of the furnace *(Fig. 2)*. A yard crane changes the doors in a matter of minutes. Furnace clearances are such that it will accommodate practically any load that can be handled by rail or truck shipment. Penstock and pressure vessel production, together with occasional outside job heats, have provided an excellent load factor on the furnace ever since its completion.

An interesting feature of the furnace construction is its relatively thin lightweight lining, which is a holdover from the knock-down panel construction of the original field furnace. Strangely enough, on furnace temperatures up to 1300°, this provides a remarkably efficient operation. Such heat as is dissipated in relatively high radiation losses during the short period of time in the upper temperature ranges is saved by the very low heat storage of the lightweight lining.

Thus, heat for heat, starting each from cold, this lightweight furnace structure will show better fuel rates per ton treated than more substantial heavy brick lined furnaces of the conventional type in wide use.

The furnace has a rated firing capacity of approximately 12 Mcf/hr of natural gas, properly distributed through seven burners firing over each side, and 10 burners under from each side, or a total of 34 burners. For convenience in piping and to make use of original equipment, combustion air is provided by three motorized blowers.

The control is a feature of this furnace. It is controlled in four zones, top and bottom, front and back. Each zone is controlled by a cam program type controller as indicated in the photograph of the control panel. One important feature is that before the program control can advance into the soak cycle, the four zones must be at the soaking temperature in order to correct any tendency of any zone to lag due to a heavier load in that portion of the furnace, or an error in cutting the cam. The four-zone controllers are supplemented with a multi-point recorder to record as many load couples, or check couples, as may be desired up to four.

The heat pattern is shown in *Fig. 3* as it was taken while the furnace was in operation. The top zones lead slightly on the up heat and all couples line out to within plus or minus 15° on the soak heat. The instruments are the latest MH-Brown Electronik air operated units.

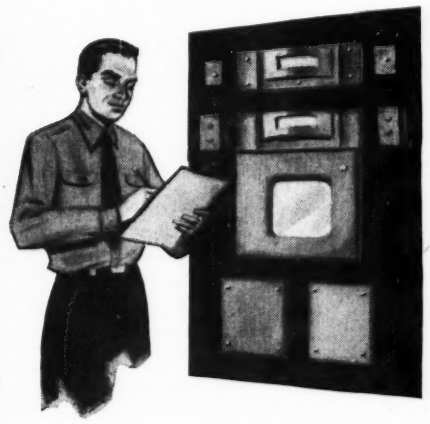
Just as GAS went to press, the editors learned of the sudden death of the author, a widely known industrial writer and retired engineer, whose articles on western industry have appeared in hundreds of nationally circulated trade magazines during the past 10 years.

Rely on this new . . .

CODE OF ETHICS SEAL

INDUSTRIAL GAS EQUIPMENT DIVISION
CODE OF ETHICS
SIGNER
GAS APPLIANCE MANUFACTURERS ASSOCIATION

. . . for highest standards of safety and durability in controls and accessories!



You can be assured that industrial gas appliances displaying *this Seal* are equipped with controls and accessories capable of meeting the highest quality standards in industry today . . . give you maximum safety and durability throughout the service life of your equipment. This is a specific requirement of the new "*Code of Ethics*" adopted by manufacturers displaying the *Seal* in their advertising and on their products. Look for the *Signer's Seal* as a routine part of your purchasing procedure!

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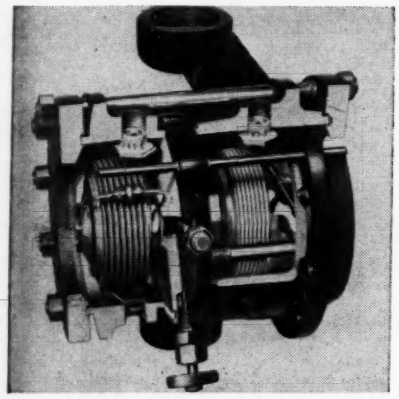


1 Orifice Meter

American Meter Co.'s regular line of mercury manometer orifice meters has been supplemented by a new metal bellows-actuated differential pressure instrument, the Dri-Flo orifice meter.

The new instrument is adaptable to all American pneumatic controllers, transmitters, differential valves, telemeters, and related instruments. Features include one-piece stainless steel bellows construction, direct full scale recording pen movement without external gearing or linkage multiplication, use of American Meter's Teflon seal stuffing box, and stainless steel or Monel metal operating parts.

One or both case cover heads may be removed without disturbing manifold piping. Stick-proof check valves with flat synthetic seats prevent distortion or bellows damage due to sudden over-range.

The instruments operate at working pressures to 1000 psi in differential ranges of 20, 50, 100, and 200 in., ambient temperatures of —25° to 175° F.

American Meter Co.

■

2 Dog Bite Kit

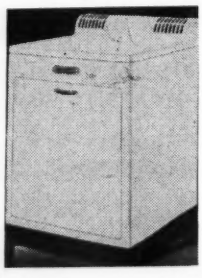
The McDonald K-9 dog bite kit has been introduced by B. F. McDonald Co. for utility workers, meter readers, etc., whose daily work in residential areas brings them into contact with dogs of varying sizes and dispositions.

The compact plastic kit holds plastic bottles containing liquid soap and antiseptic, applicator sponge, adhesive bandages, and instructions for emergency treatment.

B. F. McDonald Co.

■

3 Table Top Water Heater



Because the draft hood is built into the top, Combustion Engineering's new table top water heaters may be installed flush to the wall. Gas and water lines can be connected straight out the back of the heater, to the back and down through the floor, or to the front and down through the floor.

A special opening has been provided for installation of a temperature and pressure relief valve in both the 30- and 20-gal. sizes. An opening is also provided in the base of the heater to pipe the valve to a suitable drain.

For high input operation, both units are rated at 25,000 Btu/hr, with 21-gal./hr recovery at a 100° temperature rise. Either can be converted to low input operation.

Combustion Engineering Inc.

■

4 Aluminum Meter

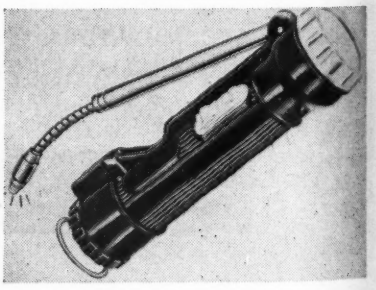
A new lightweight die-cast aluminum gas meter with a rated capacity of 415 cu ft per hr has been announced by Rockwell Manufacturing Co.

The new "415" weighs only 20 lb as compared with Rockwell's cast iron meters of comparable capacity, which weigh 62 lb.

It has a single sealing flange between cover and body, its valve plate is completely enclosed within the case, and it features oil-impregnated powdered metal bearings. The 415 has 7-in. spud centers, roll-type diaphragms, and four-chamber design "D" slide valves with duplex tangent adjustment.

Rockwell Manufacturing Co.

■



5 Industrial Flashlight

A built-in dual lighting system that provides a probe-light for pinpoint inspection

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GAS, 198 S. Alvarado St., Los Angeles 57, Calif.

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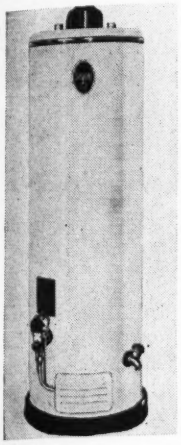
of inaccessible parts and equipment has been incorporated in a new industrial flashlight that might prove useful to meter readers.

The U. S. Electric Manufacturing Corp.'s Usalite Duo-Flex has both a 1000-ft flashlight beam and a flexible slideout cable with bulb and plastic guard. When side-arm is extended, light is automatically transferred to the small bulb. The extension tube encased in the arm can be goosenecked around corners or into deep out-of-the-way spots. The over-all extension of the arm measures 10½ in.

U. S. Electric Manufacturing Corp.

■

6 Water Heater



Greatly improved rust and corrosion resistant qualities are claimed for a newly developed glass lining which is featured in Bryant's new Crystalglas automatic gas-fired hot water heater, available in 20, 30, 40 and 50-gal. sizes.

Protection afforded by the lining is reported to be equally effective in all areas of the nation. Standard working pressure is 170 psi. Minimum heat loss is assured by heavy fiberglas insulation.

The heavy-duty steel tank is assembled in two pieces prior to the application of the glass coating. The bottom and center flue are assembled as one part, the shell and head as the other. Saddle type head construction eliminates air pockets and permits a thorough coating of glass enamel at all points.

Bryant's Protect-O-Rod (magnesium alloy anode rod) offers added assurance of water purity.

Bryant Heater Div.

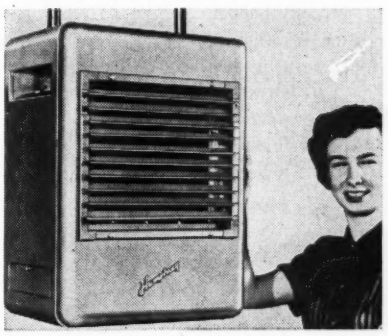
■

7 Small Flow Valves

A new line of small flow bronze or steel reducing valves for gas, air, steam, or liquid service has been introduced by Leslie Co. Applicable to a wide variety of jobs in molding plants, pilot plant operation, etc., where small flows are a problem, the new valves handle inlet pressures to 1000 psi and reduced pressures from 2 to 400 psi. Four sizes are available, ranging from 3/32 in. to 5/16 in.

Leslie Co.

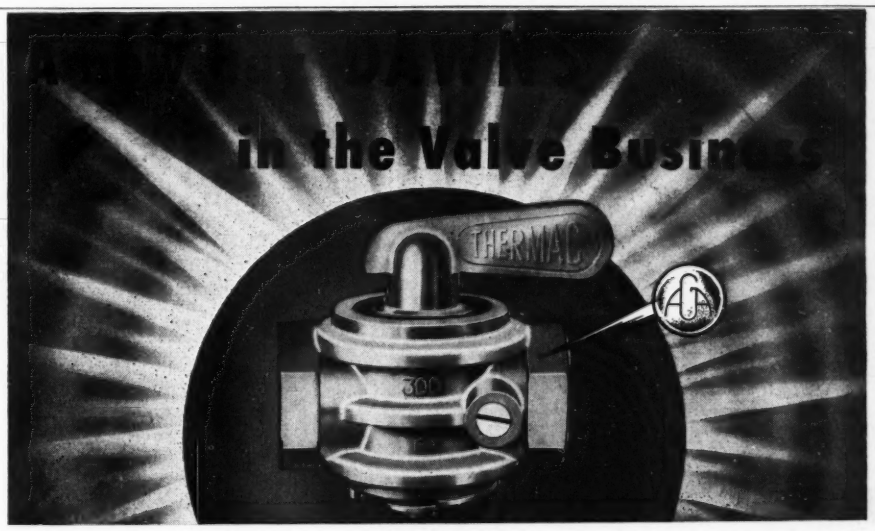
8 Unit Heater



For establishments demanding small size heaters of moderate capacity and economical cost, General Gas Light Co. has designed its Humphrey Series 40-G automatic gas unit heater. Rated input is 40,000 Btu per hour. Outside cabinet dimensions are only 17 in. by 22⅜ in. by 13¼ in.

Features include tilted front to deflect warmth downward without restricting air delivery; stainless steel, dustproof pilot; universal type cast-iron burner; six-flue heat exchanger; dependable safety controls; and rear vent that permits "close to ceiling" installation. The Model 40-G is approved for 6-in. ceiling and side clearance.

General Gas Light Co.



LARGE CAPACITY... PERMITS SMALLER, LESS EXPENSIVE CONTROLS

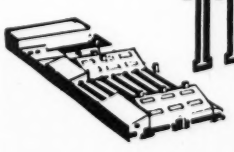
THERMAC ALUMINUM ALLOY GAS SHUT-OFF VALVE

1. GREATER STRENGTH AND RIGIDITY
2. HIGH STRENGTH, HEAT TREATED ALUMINUM ALLOY
3. EXTRA CAPACITY LOW PRESSURE DROP
4. NON-CORROSIVE
5. LOW COST
6. AGA CERTIFIED

A new idea in valves—the most revolutionary improvement in gas equipment in 40 years. So outstanding is this free-flow, low pressure drop shut-off valve, that appliance manufacturers are recalculating and redesigning their manifolds using smaller regulators and controls with savings up to $10.00 per unit.

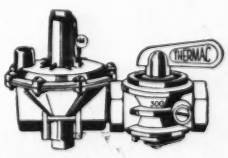
Here's the secret: the valve plug is much larger than usual so that the gas passageway is not "pinched" down. Get a sample and check it for yourself.

In strength, this specially heat-treated, aluminum alloy valve exceeds anything yet built. The valve rotor is treated with a long-life lubricant. It's AGA certified and built by Thermac, an age-old name in gas controls. Send for sample and bulletin today. Available in ½" and ¾" pipe sizes.



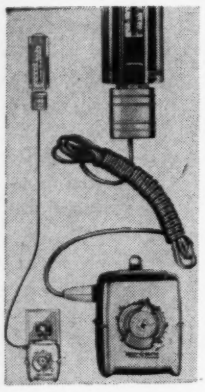
THERMAC HM COMPANY

800 EAST 108TH STREET • LOS ANGELES 59, CALIFORNIA



Order the assembly of Thermac regulator and shut-off valve to your own specifications.

9 Thermostat Heat Control



Automatic Controls Corp. has introduced a newly designed nighttime thermostat heat control which is claimed to be effective in controlling any type of furnace now controlled by a thermostat.

The Heet-O-Matic has two units connected by a 6-ft cord. A calibrated time control unit plugs into the receptacle and a heat control unit mounts beneath the thermostat. When set, the device automatically reduces house temperature by 10° at bedtime, then raises it back to normal before morning. The heat control unit when switched on by the time control, increases the temperature of the air surrounding the thermostat during the night.

Automatic Controls Corp.

■

10 Aluminum Meter

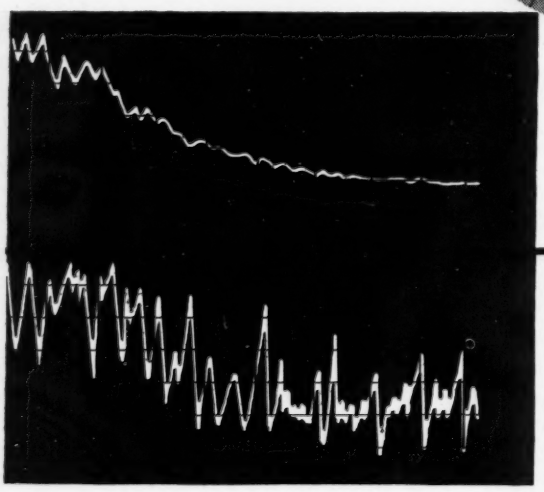
The new Sprague 240 meter has a cast aluminum case, weighs 13 lb and has a capacity of 240 cu ft per hour (½-in. differential with 0.60 specific gravity gas).

Approximately the size of the Standard 1A, the new meter's case size and connections are identical to the 1A and most parts are interchangeable.

Sprague Meter Co.

■

Lancaster puts the finger on friction



Cardiograph Reading On New Lancaster Metal Rim Diaphragm indicates no points of excess friction—uniform distribution of leather, perfect alignment of center pans, ideal weight and stiffness of leather, and proper amount of oil in leather.

Cardiograph Reading On New Diaphragm of Another Make (as received in proof) indicates excess friction. If installed in this condition, diaphragm would come in from 5% to 10% fast. (Diaphragm was later found to have non-uniform distribution of leather and center pans improperly aligned.)

Typical of Lancaster's leadership is the cardiograph designed by our engineers. It was extensively used in the development of Lancaster's new groove type metal rim diaphragm which has made such a hit with meter shop men.

Accurately checking differential of pressure under actual meter operating conditions, this cardiograph has put the finger on factors influencing diaphragm performance . . . and has helped determine the important new features found in the new Lancaster S-7 groove type diaphragm.

If you are not already using the new Lancaster groove type metal rim diaphragm for your small meter repairs and replacements, send for literature and prices today.

METER PARTS CO.

Trade Literature

11 Digger Film

"Digging For Your Future" is a 16-mm sound color motion picture developed by Bucyrus-Erie telling the story of Bucyrus-Erie equipment in action and how the equipment is developed originally. The company has published a two-color pamphlet describing, illustrating, and announcing the availability of the film. Excavators, cranes, tractor equipment, and drills are covered in film.

Bucyrus-Erie Co.

■

12 Fitting Catalog

A 28-page, four-color general catalog has been published covering the complete line of Flodar high-pressure tube and pipe fittings. Cut-away drawings and photographs illustrate the tube fittings. Engineering tables are supplemented with complete specifications on all Flodar fittings, and the catalog contains many helpful facts regarding selection of proper tubing for a given application.

Flodar Corp.

■

13 Heating Control Bulletins

A series of bulletins on the application of heating system controls has been issued by Automatic Devices Co. The four-page bulletins tell the "how" and the end results of Weather-Flo operation, and describe its application to hot water and warm air systems.

Automatic Devices Co. Inc.

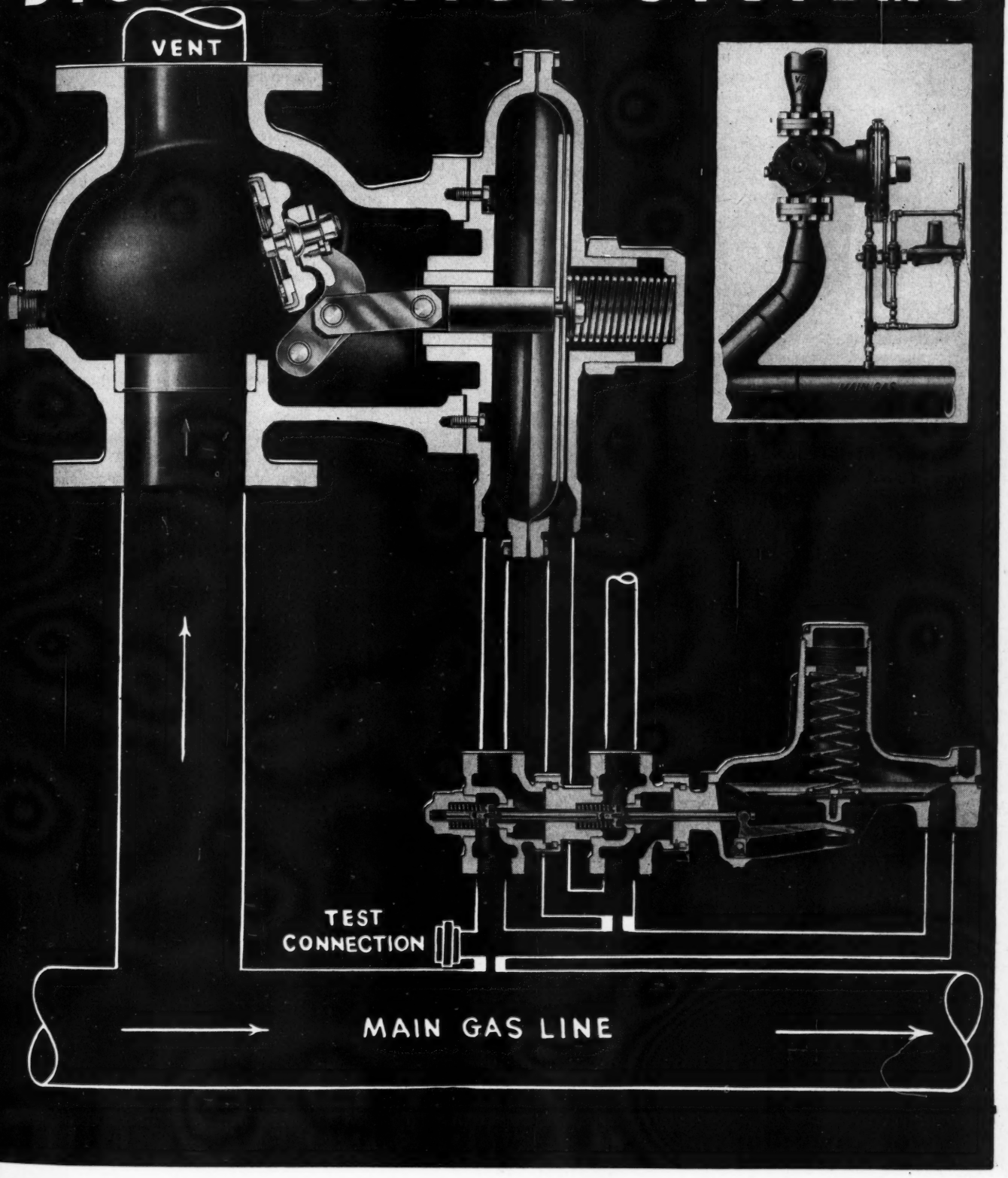
■

14 Blower Bulletin

A two-color, 32-page bulletin has been published by the Lamson Corp. cataloging products of the Billmyre Blower division and presenting information on centrifugal blowers and exhausters for air or gas handling. Typical applications of the blowers are illus-

RELIEF. . .

DISTRIBUTION SYSTEMS



trated and described, performance data are presented for air blowers and exhausters with heavy-duty cast iron housings. Technical data are included on agitation of liquids, air for combustion, and for foundry cupolas, ice making, vacuum cleaning, and pneumatic conveying.

Lamson Corp.

■

15 Temperature Control Bulletin

The first of a new series of bulletins describing its line of temperature controls has been issued by the Burling Instrument Co. The initial bulletin covers Models H-1S and V-1S, which are primarily used for high temperature safety alarms and cut-outs up to 1800° F. Included are complete descriptions of operation, dimensions, methods of mounting, and operating specifications.

Burling Instrument Co.

■

16 Technical Catalogs

Two new four-page catalogs are available from Fischer & Porter Co. (When ordering copies, use letter preceding description together with number of this notice.)

(a) Psychrometric thermometers, their installation and application, and a psychrometric table for use in interpreting dry and wet bulb readings to values of relative humidity are included in Catalog 12-A-20.

(b) Catalog 14-A-12 describes gas specific gravity measurement and control systems using the combination of Ranarex and Fischer & Porter instruments. Applications, operation, advantages, and general specifications are also included.

Fischer & Porter Co.

■

17 Industrial Bulletins

Several catalogs are available from Eclipse Fuel Engineering. (When ordering copies, use letter preceding description together with number of this notice.)

(a) Solenoid valves designated "DO" for use in installations requiring the control of gas, air, water or oil, are described and illustrated in Data Sheet M-500-T.

(b) Several models of tank heaters have been described and illustrated in a new four-page bulletin. Specifications are given for Eclipse gas-fired tank and coil units, rectangular and circular Externo units, and the Imerso unit.

(c) Bulletin H-17 describes retention type line burners which are designed for gas-fired applications where heat must be distributed over a wide area by a continuous flame which can be lighted from one point.

(d) "Furnaces for Industry" discusses standard Eclipse furnaces for every heating function: air draw furnaces, tank heaters, salt pot furnaces, large oven furnaces, small shop furnaces, forging furnaces; metal-melting furnaces.

Eclipse Fuel Engineering Co.

■

18 Technical Bulletins

Two four-page, two-color bulletins have been published recently by Gow-Mac Instrument Co. (When ordering copies, use letter preceding description together with number in heading.)

(a) The Gow-Mac thermal conductivity units are described and illustrated. In addition to this data on the fact finding and time saving devices, Bulletin TC-953 contains specifications and a table of typical deflection values.

(b) Bulletin GMH-853 presents specifications and application data on the Gas Master, which is recommended for evaluation of the thermal conductivity method and development of sampling systems.

Gow-Mac Instrument Co.

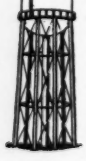
■

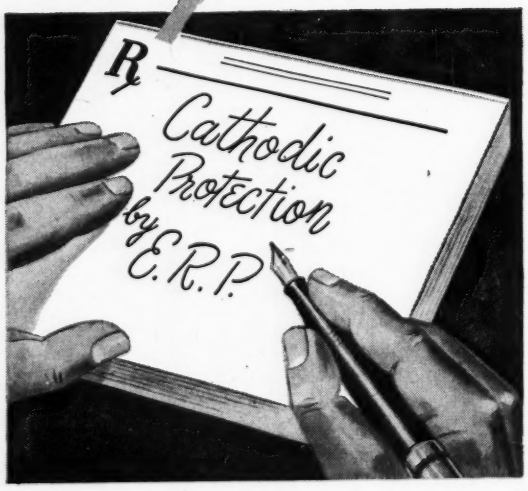
19 Pipe Specification Catalog

Specifications for all sizes of pipe from ⅛ in. to 24 in. in diameter are included in a new catalog, "Pipe and Pipe Fabrication," issued by the L. B. Foster Co. Tables give data and descriptions of all pipe from Schedule 20 through Schedule 60. API specifications are listed for casings and oil country

℞

FOR CORROSION...





You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required to achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.

Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been completely protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years,* these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

COMPLETE CATHODIC PROTECTION SERVICE • DESIGN ENGINEERING MAINTENANCE INSTALLATION EQUIPMENT

ELECTRO RUST-PROOFING CORP. (N. J.)
BELLEVILLE 9, NEW JERSEY
REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

E-27

tubular goods. The 16-page catalog also describes Foster's pipe fabrication facilities for structural uses.

L. B. Foster Co.

■

20 Heating, Cooling Booklet

Basic information about heating and cooling the home is contained in a new 24-page booklet published for the general public by the Coleman Co. In addition to discussing the principles of blended-air heating and blended-air conditioning, the booklet points up the many economies which may be realized by the home owners who install summer cooling.

Coleman Co.

■

21 Engineering Data Sheet

Detailed procedure for conducting gas-oil ratio tests of well production is covered in a new six-page application engineering data sheet issued by Foxboro. By means of a sample problem, the sheet outlines the step-by-step flow calculations, based on pressure measurements from a portable recording instrument. Capacity tables, a process diagram, and correction factor tables are included.

Foxboro Co.

■

22 Potentiometer Bulletin

Brown portable potentiometers, with direct reading temperatures, millivolt, and extended range scales, are covered in a new Minneapolis-Honeywell bulletin. Wiring diagrams, instructions, specifications, and special features are also included.

Minneapolis-Honeywell Regulator Co.

■

23 Trencher Catalog

Cleveland Trencher's Model 110 trencher is described in a new eight-page catalog-type bulletin. Various job applications within the trench size range (12 to 24 in. wide, up to 5½ ft deep) of the 110 are illustrated and the two-color bulletin presents a table of 48 available digging wheel and crawler speed combinations available.

Cleveland Trencher Co.

■

24 Indicator Catalog

Information on how manually operated portable and panel indicators are being used to measure temperature, electrolytic conductivity, or pH is contained in a new 24-page catalog just published by Leeds & Northrup.

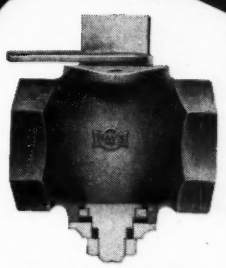
It describes the design and operating accuracy of these direct-reading indicators. Circuit diagrams show how the instruments operate. Specifications for both the indicators and accessories are listed.

Leeds & Northrup Co.

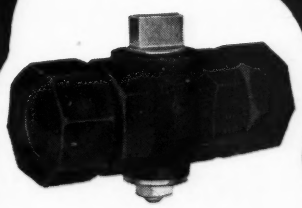
that are TOPS

IT PAYS TO BUY HAYS

7405
Iron Body, Galvanized,
Bronze Plug Stop



7490
"Key-Lok" Tamper Proof Stop
Lockwing—Iron Body,
Bronze Plug



7500
Threadless Gas Stop
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Service Line Stops—Meter Stops
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Tamper Proof and Standard Patterns

Iron Body with Brass Plug
Black or Galvanized
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Flat Head—Flat Head with Lockwing

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Quality Assured . . .
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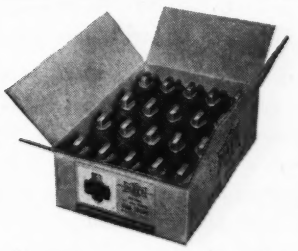
for Over 80 Years



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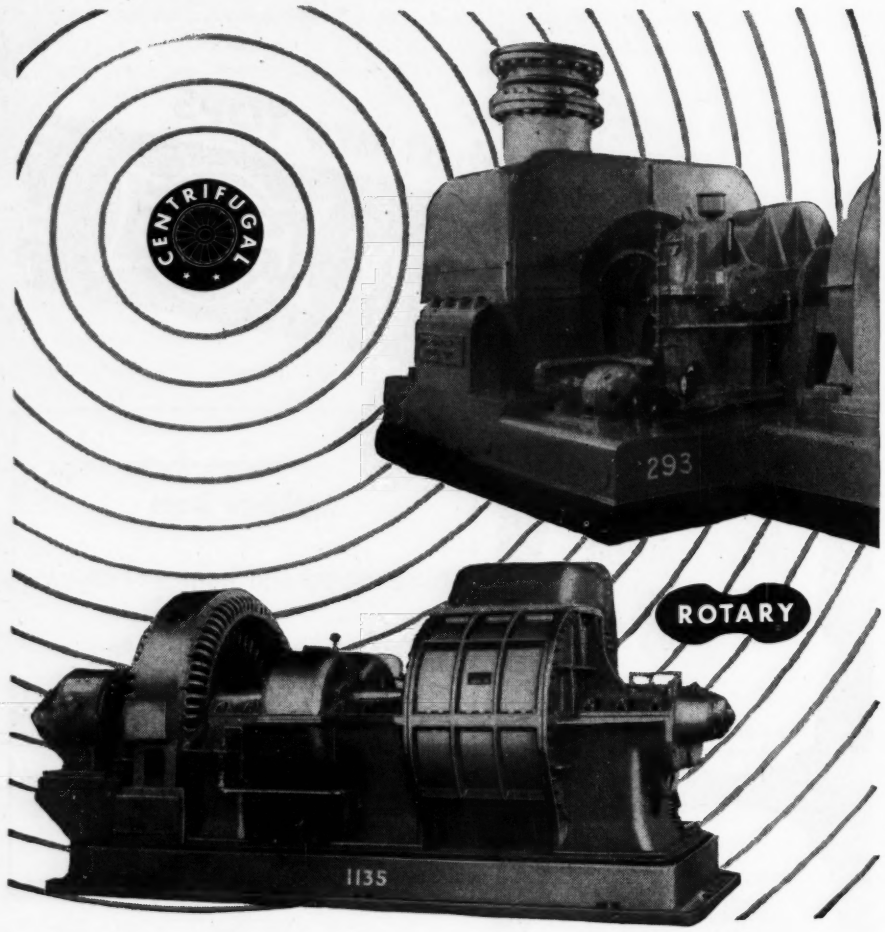

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To meet the varying problems of handling air or gas, in industrial processes, Roots-Connersville builds two complete lines of blowers and exhausters—Rotary Positive and Centrifugal. Together, they cover capacity requirements from 5 cfm to 100,000 cfm in single units. Centrifugals are available in multi-stage units, as illustrated, or in single-stage types.

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In addition to blowers and exhausters, R-C products include a wide range of gas and vacuum pumps, meters, inert gas generators and other related equipment. So, whenever you have a need for moving or measuring gas or air, we suggest consultation with the R-C Specialists.

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BLOWER BUILDERS SINCE 1854

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Thermally Thinking

Continued from page 22

"Mid-Century Conference on Resources for the Future." The conference will not endorse programs, according to R. G. Gustavson, president, but it is expected to be a sounding-board nationally for "liberal" groups, who may be expected to warn the administration and legislators generally about taking steps to make life more bearable for the natural gas industry, or any other utility.

Natural gas and the high court

The long-celebrated Phillips Petroleum Co. case again is before the U. S. Supreme Court, whose fall term has opened here, as is also another case—the appeal from the 8th U. S. Circuit Court of Appeals decision in the Northern Natural Gas Co. case—which is of interest to the natural gas industry.

In the Phillips case, there was speculation as to whether the court would dispose of it promptly by refusing to grant a review. On the other hand, the court may go through the full process of briefs, arguments, and formal opinion. The U. S. Attorney General had until Oct. 19 to file briefs in the appeal from the U. S. Circuit Court of Appeals for the District of Columbia, reversing the FPC.

In the Phillips case, it was the FPC which originally decided against taking jurisdiction over the independent natural gas producer. It was the lower court which reversed the FPC; hence, it is believed that the highest court will want to hear the case argued and decided by formal opinion rather than deny a review. If there is formal consideration, it is liable to be delayed for final decision until next spring, when the Congressional session possibly will be too far gone to permit final action on any bill to relieve the FPC of jurisdiction over producers and gatherers.

The Northern Natural Gas Co. has filed two separate appeals. One was filed by the state corporation commission of Kansas from the refusal of the FPC (affirmed by the lower court) to take into consideration the minimum

wellhead price fixed by the state of Kansas, as a basis for the cost of production in fixing the rates of the interstate pipeline company (Northern). The Kansas commission challenges FPC's right to insist on actual cost of production evidence for regulatory rate fixing, in spite of the fact that the pipeline company purchases part of its supply from the Hugoton field, covered by the state minimum rate law.

The other appeal is by Northern Natural. If the Supreme Court agrees to review the appeals, it likely will go into the issue of the use of the cost of capital as an exclusive measure of the reasonableness of the return allowance, as well as other debatable deductions from the rate base disputed by the pipeline company.

There's a chance, too, that the Supreme Court will pass on the suit by the state of Alabama to have the recently enacted tidelands oil law declared unconstitutional. This law, which affects title of natural gas as well as oil developed off the coastal states, also is under attack by the state of Arkansas at the U. S. District Court level. Legal observers believe that the short-cut attempt by Alabama to get the case directly before the high court perhaps will be thrown out. If it is heard, new Chief Justice Earl Warren, until recently Governor of California, is expected to disqualify himself.

Current Reading

GLOSSARY OF TERMS USED IN PETROLEUM REFINING—This 188-page book contains 2000 words and phrases pertaining to the petroleum industry and a highly useful tool for the petroleum refiner's secretary—an appendix with both Gregg and Pitman shorthand symbols for each of the terms in the glossary.

Published by the American Petroleum Institute, 50 W. 50th St., New York 20, the glossary is an 8½- by 10-in. cloth-bound book, priced at $6 per copy.

CATHODIC PROTECTION WITH ZINC ANODES—This report, prepared for the American Zinc Institute by Ebasco Services Inc., is intended to supplement the report, "Zinc as a Galvanic Anode." Additional design criteria for zinc anode installations are included in this report which simplify determination of the size and number of anodes required for specific installations. Discussion is included on the use of these data.

Subjects covered include corrosion of underground structures and cathodic protection; properties of zinc anodes; cathodic

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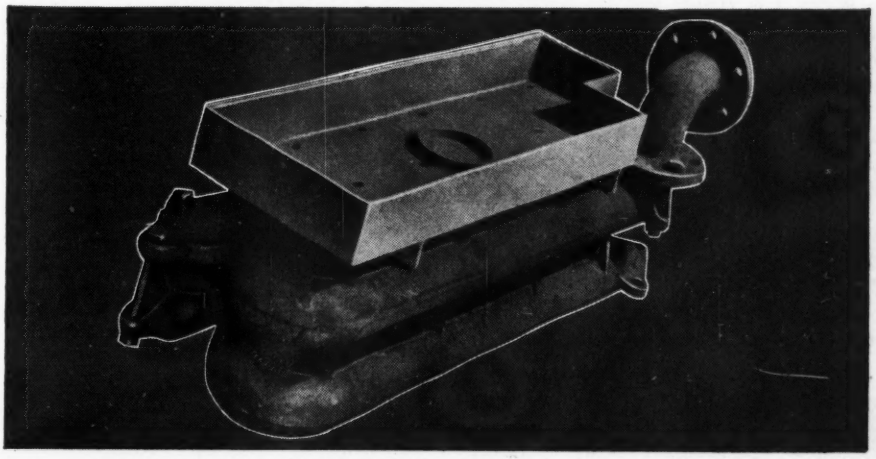

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EASY TO INSTALL—One pan fits on top of each stack of sections. Simple downcomer pipe for feed—minimum number of connections.

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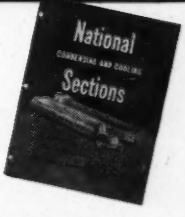


protection of steel distribution piping systems; cathodic protection of transmission pipelines; zinc anode systems design and installation; heat exchangers and condensers; zinc anode protection on old lines, and many others.

The 49-page book, with 36 illustrations, is available free of charge from the American Zinc Institute, 60 E. 42nd St., New York 17.

SELECTION AND SIZING PRESSURE RELIEF VALVES TO COMPLY WITH ASME BOILER CODE REQUIREMENTS —Published by McDonnell & Miller Inc., this 24- page booklet is intended to provide complete and easy-to-use data for accurately determining the output of all types of boilers, tanks, and heaters.

Formulas and tables cover recommended relief valves for cast iron boilers and steel boilers, as well as those boilers for which there is no nameplate data or set procedures for establishing the output. Also covered are hot water supply heaters and tanks, heat exchangers, and unfired pressure vessels.

Copies are available free of charge from McDonnell & Miller, 3500 N. Spaulding Ave., Chicago.

VENT INSTALLATION HANDBOOK —More complete and helpful than the original "Blue Book of Venting," this book has been published by William Wallace Co. to replace the book first published more than two years ago.

The information contained in the new reference book has been developed within recent months and the newly established operating characteristics of gas vents are included to provide a specific design that will function perfectly.

Copies of the book are available from William Wallace, Metalbestos Div., Belmont, Calif.

DISPLACEMENT GAS METERS— Reprinted as a service to the gas industry, this 275-page book draws on the extensive experience of American Meter Co. accumulated in the field over a period of 117 years.

Edited by John C. Diehl, the handbook covers all phases of displacement meters from fundamental principles of gas measurement to proving, maintenance, and repair of tinned steelcase and ironcase meters. Illustrated with pictures, diagrams, and charts, the book also includes many tables and other data. Contents are cross-indexed for ready reference and printing is on high quality coated paper stock, sturdily bound in imitation leather.

The books are available from American Meter Co., 1513 Race St., Philadelphia, at a cost of $4.50 per copy.

THE GOLDEN BOOK OF HEATING KNOWLEDGE — This 50-page book has been designed to provide the homeowner with enough basic heating know-how to intelligently appraise the different types of heating systems. It presents usable, basic information about warm air and wet heat systems that will enable the consumer to get a better understanding of the advantages and disadvantages of the wide range of heating equipment offered in today's market.

The book is available for 25 cents from Norge Heat Div., Borg-Warner Corp., 346 E. South St., Kalamazoo, Mich.

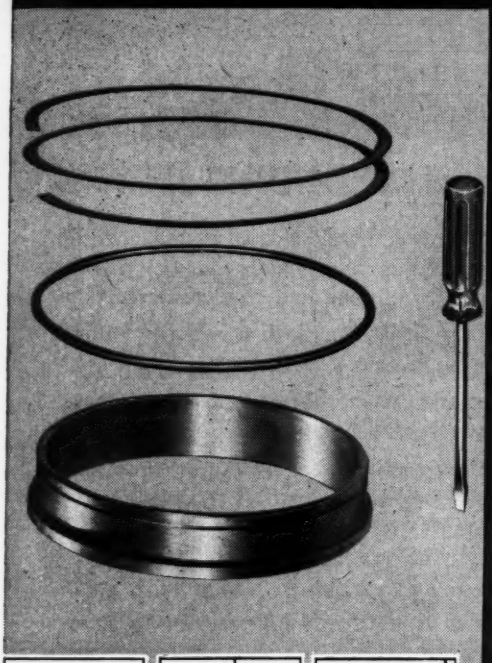
STANDARDS ARE YOUR BUSINESS— Standards of production and their value as tools of management are defined in this 24-page booklet. Issued by the American Standards Assn., the revised booklet gives the philosophy and objectives of the voluntary standards movement in this country and contains considerable new material, including a section on federal government policy toward industry standards. Included are specific examples of recent savings through standardization effected by leading U. S. corporations.

Copies are available without charge from the ASA, 70 E. 45th St., New York 17.

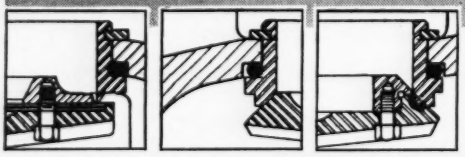
. . . announcing

REYNOLDS' REMOVABLE ORIFICES

in single district station and high pressure line regulators which has been in use 3 years



1. To remove orifice, a screw driver is the only tool needed.
2. Orifice may be had in any metal, normally stainless steel.
3. Types—Seats for orifices: Flat Disc—Composition or Leather; Metal to Metal; Metal to Metal with "O" ring
4. "O" ring between valve body and seat assures perfect parallel seating as well as perfect height seating. Does not require close valve height adjustment.
5. Valve seats may be sized as much as three regulator sizes smaller. For example, a 12" regulator may have inserted valves the size of 10", 8", 6" regulators.



METAL TO COMPOSITION VALVE SEAT | METAL TO METAL VALVE SEAT | METAL TO RUBBER VALVE SEAT

GAS CONTROL Since 1892

Reynolds Gas Regulator Co.

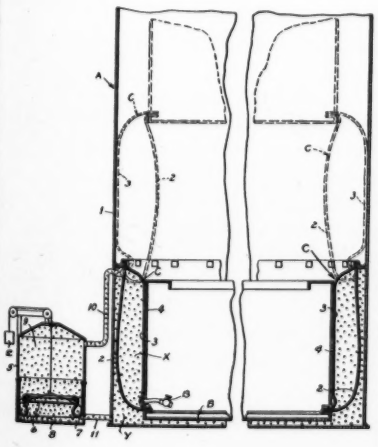
ANDERSON, INDIANA, U. S. A.

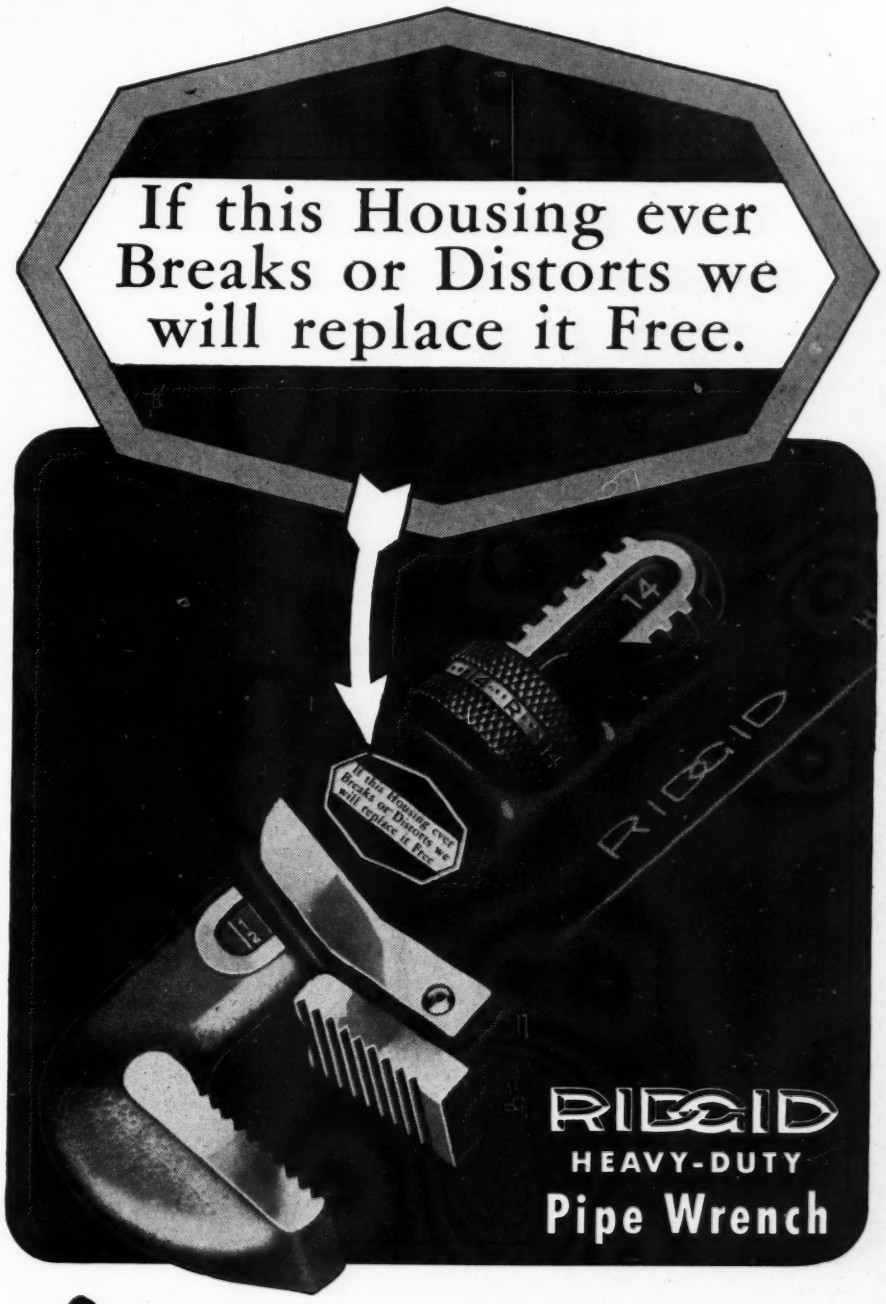
Newly patented piston-type gas holder

THIS invention relates to piston-type gas holders of the kind in which the annular space between the piston and the container side wall is closed or bridged by a "dry seal" consisting of a flexible, curtainlike sealing means attached to side wall and piston and proportioned so as to provide for the rise and fall of the piston. In conventional gas holders of the general type or kind above referred to the dry seal between the piston and the container side wall is constructed in whole or in part from fabric or some other suitable flexible material treated so as to render it gas-tight. Notwithstanding the fact that no expense is spared in the construction of such dry seals, there is always the possibility of gases leaking and combining with the air in the space above the piston to form an explosive mixture which creates a fire hazard.

The main object of the invention is to overcome or minimize this inherent defect of conventional dry seal, piston-type gas holders. To this end, a gas holder has been devised which, in its simplest form, is composed of a container that constitutes a stationary portion of the gas storage chamber of the apparatus, a piston in the container which is adapted to move relatively to the container so as to increase or decrease the volume of the storage chamber, and a sealing means for the piston, formed by a flexible, baglike structure inflated with inert gas, bridging the space between the container and the piston and attached to the parts.

J. H. Wiggins
Pat. No. 2,639,229





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ASSOCIATIONS

More than 500 at NACE south central region meet

A full schedule of papers and technical practices committee meetings concerned largely with the various aspects of corrosion protection occupied the three-day meeting of the south-central section of the National Assn. of Corrosion Engineers held Oct. 7-9 at Tulsa. A total of 531 registrants made the meeting one of the largest regional affairs to be held by NACE.

More-than-average attendance was drawn to the symposium on pipeline corrosion, which featured many papers of interest to gas people, including one by B. J. Whitley Jr., Tennessee Gas Transmission, on the cathodic protection of plant yards with distributed anode systems, and a discussion of the effects of impurities on the performance of magnesium anodes by H. A. Robinson, Dow Chemical Co.

Other sessions had to do with oil and gas production, corrosion in the processing plant, and oil and gas transportation, which featured a paper by Norman Hackerman and B. L. Cross, of the University of Texas, on the use of the null bridge method for the classification of corrosion inhibitors. Edward C. Greco, United Gas Corp., presented a talk on the corrosion of centrifugal compressor phosphor-bronze oil sealing sleeves.

During the luncheon session, Dr. Clark A. Dunn emphasized the importance of cooperation between industry and education for the benefits of both.

Considerable interest was shown in the meeting of the subcommittee on the testing of inhibitors. Both users and manufacturers are interested in the subcommittee's project to select a procedure that can be used as a standard method of screening corrosion inhibitors. A test program has been set up between manufacturers and gas utilities.

Symposium discusses water heater corrosion

Information about the causes of water heater corrosion and suggestions for direct action that may enable manufacturers themselves to combat corrosion more effectively were presented during a recent four-day symposium conducted at Case Institute of Technology, Cleveland, and sponsored by GAMA.

One of the principal subjects discussed at the meeting, attended by 57 manufacturers of water heaters, was the possibility of classifying waters in five or six groups so that the manufacturers might reasonably predict the useful life of a tank using the various types of water. This discussion has resulted in preliminary conversations with representatives of the American Water Works Assn.

In line with the classification of waters, Thomas S. Howald of Chase Brass & Copper Co. reported that his company found such classification, although not yet complete, very helpful in anticipating and controlling corrosion in certain geographic areas.

Dr. William Stericker, Philadelphia Quartz Co., showed data and photographs to prove that proper application of either one or two different sodium silicates will stop the corrosion in hot water systems. Dr. George Hatch, Calgon Inc., presented the case for the use of polyphosphates as a means of controlling corrosion; Dr. Edward G. Bobalek, of Case, reviewed the behavior of plastics in hot water; and Dr. Weast closed the conference with a discussion of the corrosion of steel and galvanized steel.

Utilities challenged to act in development program

"Are you taking enough time out to digest and review, in all seriousness, the Action Program for Gas Industry Development? Or have we, in cooperation with the president of AGA, simply painted a portrait of the future for gas appliance sales on water?"

This challenge to gas utility companies was laid down by Stanley Hobson, president of Geo. D. Roper Corp. and past president of GAMA, before the New Jersey Gas Assn.'s annual meeting in Spring Lake recently.

"Now that we have put together a beautiful booklet and top echelon meetings have been held, what do we do to implement the program?" Mr. Hobson asked.

He followed with leading questions directed to the utilities:

Has top management met with the principals of your company to define and interpret the 15 points as recommended?

Have you put into writing these definitions of interpretation of your company policy?

Have you submitted your company policy and definitions to AGA as a matter of record?

Have you placed a copy of your company policy and definitions in the hands of each of your suppliers so that they may know exactly and precisely where you stand in order to cooperate with you to the fullest in your own planning?

Expanding on the last question, Mr. Hobson said:

"Manufacturers' representatives and divisional people can only work in complete cooperation and coordination with your sales department when they know what your policy and your viewpoints on the 15-point program of action.

"To implement the program so that manufacturers may know specifically where to direct their efforts for the greatest and most beneficial result is going to be a herculean task. We must face up to this task because it is most important that all of us know precisely where each one stands if the plan for action is to work.

"We (Roper) should have in our files a

Seated together at the NACE meeting were (from left) W. H. Stewart, Sun Pipeline Co., Beaumont, Texas, chairman of the technical program; H. L. Bilhartz, chairman for 1954; Derk Holsteyn, director for the south central region; and H. E. Waldrip, outgoing chairman.

Speakers' table at luncheon meeting. From left: Dr. Clark A. Dunn, Oklahoma A & M; Clifford L. Barr, Shell Oil, vice chairman for 1954; John E. Loeffler, Thornhill-Craver Co., secretary-treasurer; L. A. Hugo, Phillips Petroleum, chairman of committee on arrangements; A. B. Campbell, NACE executive secretary.

copy of every utility's interpretation of policy on the . . . program. Each of our customers should have in his files an interpretation from us as to where we stand on . . . the program. This will determine where the effort should be put forth to produce the quickest and best results. As I view it, unless our division managers have this information, it is going to be rather difficult for them to discuss constructively with any of your sales management people the problem of merchandising and its effect in your community for the future."

Continuing with his questioning, Mr. Hobson asked if the utilities have a firm and complete grasp of the marketing opportunities within the areas they serve so that sales objectives and quotas can be agreed upon on a most constructive basis, and selling programs can be designed and developed to meet these objectives. Significantly, he asked what the utilities are doing now to tie in and cooperate with the gas range division's Operation Sales program, sponsored by GAMA.

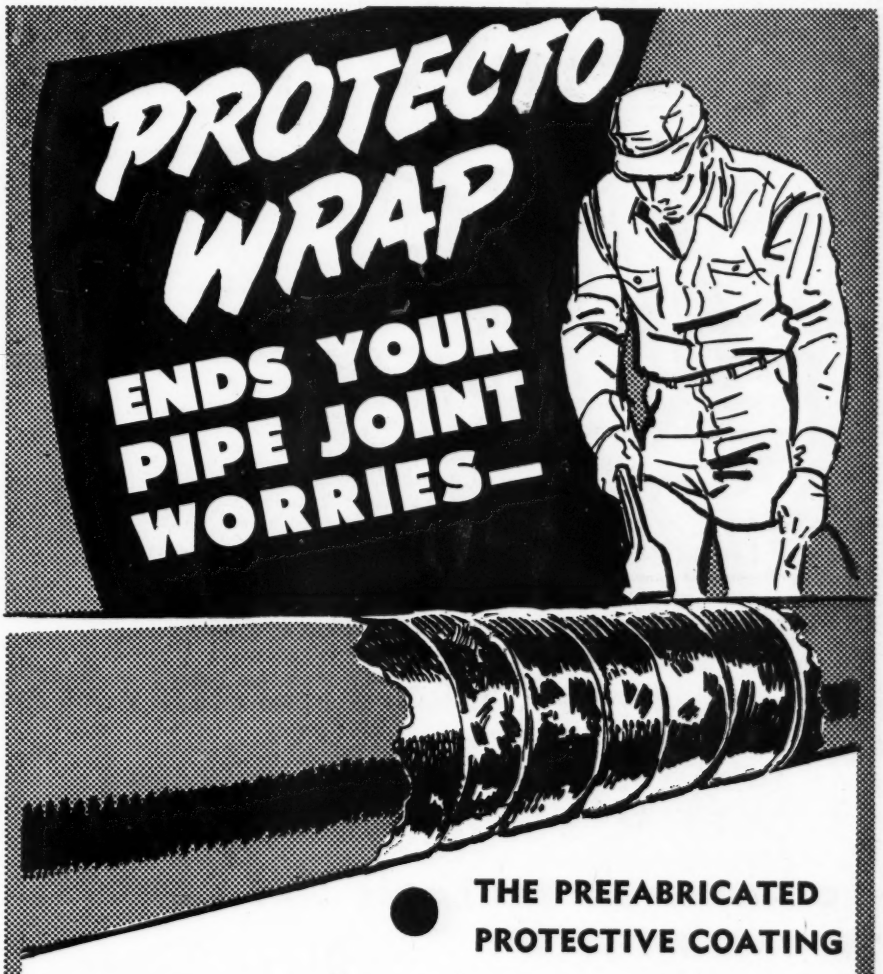
J. T. Wolfe, Consolidated Gas of Baltimore, speaking at the same meeting, tackled the problem of when and how the program can be expected to show results. Said he: "I can't get away from the disturbing impression that there are those, both inside and outside of the gas industry, who look upon this program as a patent medicine concocted and administered by AGA to its members. As such it will never be successful. There are others . . . who, through our failure to present the objectives clearly, seem to believe that the entire action program has now been concentrated in the 10 so-called test cities. If that were so, then a lot of time (some of it mine) has been wasted.

"The fact is that the program has already been successful in some degree, not because it has obtained a lot of publicity and caused a lot of conversation, but because some individual gas utility executives have resolved that their companies will do a better job of selling or promoting gas appliances, with greater emphasis on top quality appliances and with more effort to reach the new homes as well as the replacement market. Some appliance manufacturers likewise have resolved to make a better product and to promote it more aggressively.

"In the long run, the success of this urgent program will be measured in terms of the number of individual gas utility executives who assume responsibility for developing an adequate sales volume of gas appliances in the territories served by their companies. This is the key point of the entire program, and the key word is 'adequate.'

"Some months ago my companies could have subscribed to all 15 points of the action program without batting an eye. Then we got to thinking about that word 'adequate.' And the more we thought about it, the more we realized we had no good idea of what constituted an adequate volume of appliance sales in the territory we serve.

"Before we got through thinking about



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- Excellent bond to adjacent coating and pipe.
- Conveniently applied to full 3/32 inch thickness.
- No waste of bituminous material.

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OPERATION BLUE FLAME

FOR GAS UTILITIES EVERYWHERE

A Great NEW TV Show featuring

CALORIC GAS COOKING STAR

Dione Lucas

WHAT IS OPERATION BLUE FLAME?

It's a colorfully presented promotional package including 26 half hour television programs starring Dione Lucas and her cooking artistry. The program is on film and is set in a New Freedom Gas Kitchen, featuring gas cooking at its finest.

WHO IS DIONE LUCAS?

TV's queen of culinary experts, Dione Lucas is the nation's leading saleswoman of gas appliances. Her programs in Boston, New York and Philadelphia have consistently *outpulled any similar show ever presented.*

MEET TODAY'S MERCHANDISING CHALLENGE!

Here's a truly low-cost merchandising program, designed specifically for the gas utility. It's a modern means to meet on a unified level the costly television productions of electric competition. And remember, this program has the solid support of not only participating utilities but also of the Caloric Stove Corporation . . . the largest advertiser in the gas range industry.

Now for the first time . . . *a national TV show* . . . available to utilities for sponsorship at the local level as part of a complete merchandising package to sell *gas* cooking to the American housewife!

The Dione Lucas Show is now being sponsored by the following utilities . . .

Arlington Gas Light Company
Beverly Gas & Electric Company
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Boston Consolidated Gas Company
Brockton Taunton Gas Light Company
Brooklyn Union Gas Company
Canon Gas Service Company
Central Indiana Gas Company
Citizen Gas & Coke Utility
Citizens Utilities Company
Connecticut Light & Power Company
Connecticut Power Company
Danbury & Bethel Gas & Electric Light Co.
Derby Gas and Electric Company
East Ohio Gas Company
Fall River Gas Works Company
Fitchburg Gas & Electric Light Co.
Gloucester Gas Light Company
Hartford Gas Company
Haverhill Gas Light Company
Indiana Gas & Water Company
Kokomo Gas and Fuel Company
Lawrence Gas & Electric Company
Lehigh Valley Division of United Gas Improvement Co.
Lone Star Gas Company
Lowell Gas & Electric Company
Lynn Gas & Electric Company
Malden & Melrose Gas Light Company
Michigan Consolidated Gas Company
Mississippi Valley Gas Company
New Britain Gas Light Company
New Haven Gas Light Company
North Hampton Gas Light Company
Norwood Natural Gas Company
Ohio Fuel Gas Company
Old Colony Gas Company
Peoples Water & Gas Company
Philadelphia Gas Works
Portland Gas & Coke Company
Providence Gas Company
Pueblo Gas & Fuel Company
Reading Gas Division of United Gas Improvement Co.
Salem Gas Light Company
Springfield Gas Light Company
Suburban Gas & Electric Company
Wachusett Gas Company
Wallingford Gas Light Company
Washington Gas Light Company

For complete information, write or wire to Caloric® STOVE CORPORATION, TOPTON, PA.

it, we found it necessary to reorganize and considerably expand our sales department and to strengthen our efforts both at direct appliance selling and at dealer promotion. The results have been strikingly good, but still we don't know if they're adequate.

"The next step is market research. Some day we shall know what 'adequate' means."

Huge turnout expected for API's 33rd annual meeting

Leading representatives of government, banking and insurance, business in general, and all phases of the oil industry will address the thousands of oil men who will attend the 33rd annual meeting of the American Petroleum Institute to be held in Chicago, Nov. 9-12, with headquarters in the Conrad Hilton hotel.

General session speakers will be Lewis W. Douglas, chairman of the board of the Mutual Life Insurance Co. of New York, and Secretary of the Interior McKay.

One session of the transportation division will feature talks by George F. Downs Jr. and George R. Tait, Phillips Petroleum, on "Formulas for Selecting Pipeline Diameter for Minimum Investment," and C. C. Bledsoe, Mid-Western Constructors Inc., on "Advance in Construction Techniques for Pipelines."

GAMA, AGA to publish new appliance service manual

One of the first dividends of the Action Program for Gas Industry Development will be in the form of a new gas appliance controls service manual, now being prepared by GAMA and AGA.

The rapid obsolescence of previously published service manuals will be overcome by producing the new manual in loose-leaf form so that supplemental sheets can be inserted when changes occur. The manual will be sold on a subscription basis and subscribers will be kept up to date with interim mailings.

In addition to the appliance controls service manual, a general appliance instruction book will be prepared. This will be a permanent-type volume to be used primarily as a reference manual or for serviceman training purposes.

Insurors may insist on conformance with new code

Even if state regulatory bodies do not adopt the forthcoming revision of the gas portion of ASA Code for Pressure Piping, utilities may be forced to give it consideration upon the insistence of their insurance companies. This belief was expressed by F. G. Sandstrom, of Consolidated Edison Co., New York, at the annual meeting of the New Jersey Gas Assn. held in September.

In reviewing varying effects of state codes issued during the past few years, he pointed out that although distribution companies in New Jersey are fortunate that their state order fundamentally covers only transmission mains, there are certain inconsistencies that affect the distributor.

How will the new code affect the future of gas distribution? Mr. Sandstrom expects that "many states and municipalities will include this code in their regulations. If (it) is adopted by the regulatory bodies having jurisdiction . . . you will be required to design, construct, and operate your system in accordance with its provisions."

Although the ASA policy does not have any retroactive features and normally applies only to new construction, an existing system that does not reasonably conform to the new code may be required by the insurance companies to make changes, inasmuch as "some companies are already having difficulty obtaining public liability insurance."

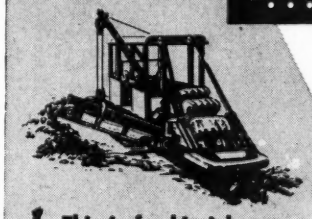
Asserting that the industry cannot afford disasters, Mr. Sandstrom reminded his listeners that "the complete failure of a regulating station is a serious thing. Some companies are protecting against such failures by installing mechanical or liquid relief seals. In order to protect such a system against the complete failure of a regulator, it may be necessary to install seals that have a capacity of 30 to 40 times the regulator capacity."

This is especially true on the systems when the inlet pressures are maintained during

It takes a FULL team

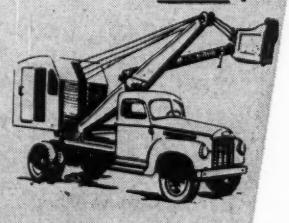
...whether it's mushing

...or digging equipment



1. This is for big jobs

2. This is for medium jobs



3. Sherman for all other jobs

On many excavating jobs the use of big equipment is costly and time-consuming. The Sherman Power Digger is designed so that you get all the advantages of power digging on these jobs. Thousands of users have proved that the Sherman Power Digger reduces costs. Write today for descriptive literature J9.

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the light load period. Other companies are installing various types of monitoring or series regulators, he said.

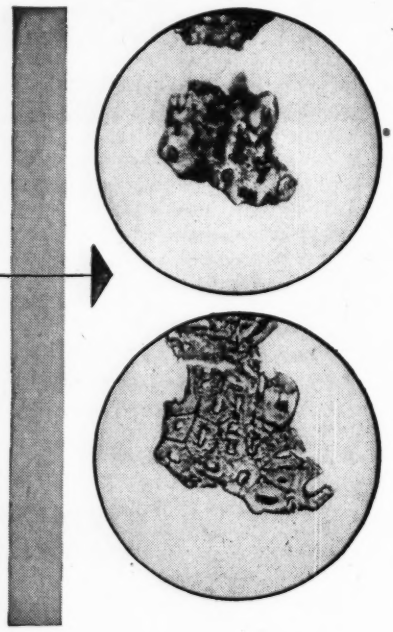
Rocky Mountain Gas Assn. celebrates 10th year

More than 300 gasmen, heating contractors, plumbers, and dealers attended the recent banquet at the Shirley-Savoy hotel in Denver celebrating the 10th anniversary of the Rocky Mountain Gas Assn.

Presiding at the affair was D. A. Bell, president of the association, who shared the head table with other officers, industry leaders and civic officials. Robert Hendee, Colorado Interstate Gas president, spoke.

Some of the 300 people who attended the banquet celebrating the 10th anniversary of the Rocky Mountain Gas Assn.

PROOF!



1. CARBOSEAL ANTI-LEAK
Trade-Mark

stops leakage due to dried-out fiber packing in bell-and-spigot joints.

PROOF: The dry jute fiber (magnified cross-section, top) swells as much as 44% when it's treated with CARBOSEAL anti-leak (bottom). In a joint all the fibers swell, openings between them close up, and leakage stops.

2. CARBOSEAL anti-leak gives lasting results.

PROOF: Distributors of dry gas have used enough CARBOSEAL anti-leak to treat 13,000 miles of 3-inch equivalent main. And the first joints treated with CARBOSEAL anti-leak—20 years ago—are still tight.

3. CARBOSEAL anti-leak is inexpensive.

PROOF: Cost of CARBOSEAL anti-leak to treat 1 mile of 3-inch equivalent main is about $100.

4. CARBOSEAL anti-leak is easy and economical to apply.

PROOF: Prove this for yourself. Write for a copy of our booklet, Form 4506 — also, our 16 mm. color-sound movie, "CARBOSEAL Anti-Leak," which we will lend you without charge.

CARBOSEAL ANTI-LEAK

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A Division of Union Carbide and Carbon Corporation
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Safety awards presented to 10 top companies

During the fifth annual conference of the AGA accident prevention committee held recently in Buffalo, top safety awards were given to 10 members companies for achieving the best accident prevention experience in 1952, according to number of employees, transmission companies and type of gas used.

The 10 top companies are the Ohio Fuel Gas Co., Columbus; Consolidated Edison of New York; Amarillo (Texas) Gas Co.; Philadelphia (Pa.) Gas Co.; New Orleans (La.) Public Service Inc.; Florida Power & Light Co., Miami; Suburban Gas & Electric, Revere, Mass.; Fitchburg (Mass.) Gas & Electric Co.; Spokane (Wash.) Gas & Fuel Co.; and Michigan-Wisconsin Pipe Line Co., Detroit.

The 93 companies listed below received awards for reducing accident frequency 25% or more in 1952 as compared with 1951:

Ohio Fuel Gas, Consolidated Gas Electric Light & Power of Baltimore, Hope Natural, Equitable Gas, Washington Gas Light, Atlanta Gas Light, United Fuel Gas, United Natural, Lone Star Gas, Oklahoma Natural, Amarillo Gas, Milwaukee Gas Light, Central Electric & Gas, Iowa-Illinois Gas & Electric, City Public Service Board, Worcester Gas Light, Mountain Fuel Supply, Memphis Light, Gas & Water Div., Houston Natural Gas, New Orleans Public Service, Gulf States Utilities, Empire Gas & Fuel.

Madison Gas & Electric, North Penn Gas, Malden & Melrose Gas Light, Iowa Public Service, North Shore Gas, Peoples Natural Gas, Southern Indiana Gas & Electric, West Tennessee Gas, Kings County Lighting, Kansas Power & Light, Brooklyn Borough Gas, Long Beach Municipal Gas Plant, Chattanooga Gas, Northampton Gas Light.

Community Public Service, Central West Utility, Hagerstown Gas, Coleman Gas, Alexandria Municipal Natural Gas System, Standard Gas Co., City of Corpus Christi Dept. of Public Utilities, Southeastern Michigan Gas, Greeley Gas, Missouri Utilities, Indiana Gas Distribution, Pavillion Natural Gas, Rockland Light & Power, Wakefield Municipal Light Plant, Penn York Natural Gas, Michigan-Wisconsin Pipe Line, Michigan Gas Storage, Texas Eastern Transmission, East Tennessee Natural, Mississippi River Fuel, Pan American Gas, Houston Pipe Line Co., Texas Gas Transmission, Texas Illinois Natural Gas Pipeline, Amarillo Oil, Interstate Natural Gas, Commonwealth Public Service, Alabama-Tennessee Natural Gas.

Kentucky West Virginia Gas, Philadelphia Electric, Rochester Gas & Electric, Florida Power & Light, New

Bedford Gas & Edison Light, Tampa Gas, Seattle Gas, Washington Gas & Electric, Manchester Gas, Blackstone Valley Gas & Electric, Pennsylvania Gas, Florida Public Utilities, Fitchburg Gas & Electric, Green Mountain Power, Middleboro Gas & Electric Plant.

Greenfield Gas Light, Greenwich Gas, Spokane Gas & Fuel, Northwestern Utilities Ltd., Canadian Western Natural Gas, Victoria Gas, Winnipeg & Central Gas, British Columbia Electric, Quebec Power, Quebec Hydro-Electric Commission, Consumers Gas Co. of Toronto, and Transcontinental Gas Pipe Line Corp.

Progress report issued on economics of househeating

A progress report on the economics of gas househeating and related load characteristics with selected case studies has just been issued by the AGA.

The study, jointly sponsored by the committee on economics and the committee on rates, entailed obtaining information on several aspects of the gas househeating load from approximately 25 widely scattered companies, and encouraging more utilities to undertake load characteristic studies and special local studies on the present and potential gas heat load.

While the final report and evaluation is not expected until the end of the year, the studies completed to date were considered sufficiently valuable to justify publication at this time. Copies are available from the Bureau of Statistics, AGA, 420 Lexington Ave., New York.

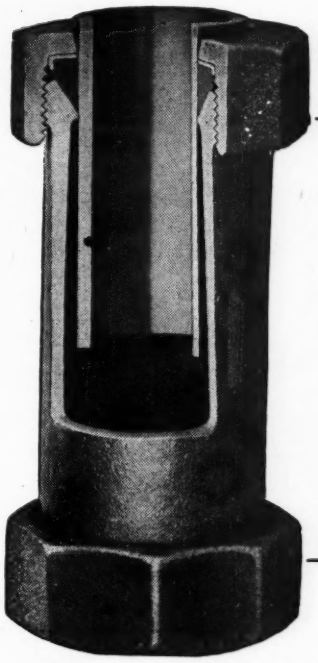
Association Notes

Harold Massey, assistant managing director of GAMA, has been re-elected to serve his third consecutive term on the six-man board of review of the American Standards Assn. He is also a member of the association's standards council, of the miscellaneous standard board, and an alternate in the conference of executives of organization.

The American Gas Assn. is one of 11 trade associations honored last month by the National Safety Council. The award was presented for general excellence in safety services and for the association's contribution to the reduction of occupational injuries in the gas industry.

The international conference on complete gasification of mined coal is scheduled for Liege, Belgium, May 3-8, 1954. Detailed information and application forms may be secured from the Institut National de L'Industrie Charbonniere, 7 Boulevard Frere-Orban, Liege, Belgium.

Five companies have been elected to membership in GAMA. They are: The Parsons Co., Newton, Iowa, manufacturer of trenching machines; Raypak Co. Inc., El Monte, Calif., manufacturer of copper tube boilers; Coroaire Heater Corp., Cleveland; Modern Controls Corp., Centerline, Mich., and Locke Stove Co., Kansas City, Mo. The last three are all manufacturers of gas incinerators, and bring to 13 the number of companies belonging to the incinerator division.



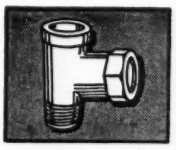
NORMAC

Couplings, Sleeves and Fittings

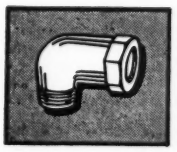
for maximum deflection, ease of "stabbing," complete confinement of the rubber!

So close are "Normac" rubbers confined at the gasket tip that possibility of flow is reduced almost to "nil." These couplings, sleeves and fittings . . . approved by gas utility men across the country for their time-saving features, ease of handling and dependable service . . . are available in a complete range of sizes. Made from air furnace malleable iron they provide greater wall thickness than pipe on which used.

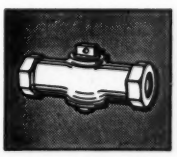
NORMAC COUPLINGS are made with 5" centers in all sizes. NORMAC SLEEVES are identical in design except that they are made with 10" centers. Nuts and gaskets are interchangeable.



Compression-End Service "Tee"—First fitting of this type ever produced with full coupling depth and special threads on male end to prevent dropping into old hand taps when used to replace standard threaded fittings.



Compression-End Service "Ell" — Extra depth makes it possible to "stab" pipe into stops and without measuring, pull back a safe distance to allow ultimate deflection eliminating possibility of strain against tap in main.



Compression-End Iron Body Brass Core Service Stopcocks—End the necessity of threading on the job plus the elimination of the threads themselves—combining all the advantages of NORMAC COUPLINGS and the best in stopcock design. 2½" coupling depth on each end.

Normac Brass Fittings Developed in 1939 for Use with Copper Tubing—Our complete line of brass fittings can be used either on new installations or where copper is run through old steel pipe in large or small openings. The center to end dimensions of NORMAC TEES correspond with old malleable iron fittings. This feature is extremely important in the use of these fittings in one foot openings where the tubing must line up with the steel which has been removed.

Write for the NORMAC CATALOG of Gas Distribution Equipment

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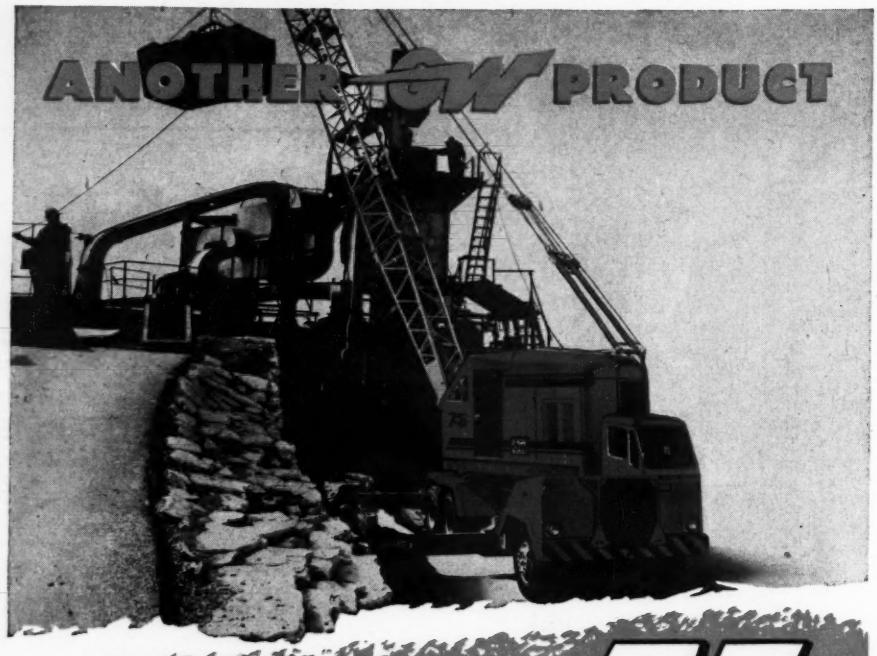
122 SOUTH MICHIGAN AVENUE - - - CHICAGO 3, ILLINOIS

Couplings • Motor Bars • Sleeves • Cocks • Bell Joint Clamps • Service Tees & Ells



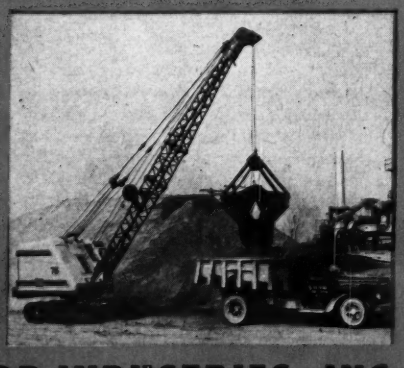
GarWood 75

A Heavy-Duty Truck Crane that can Lift up to 20 Tons!

Gar Wood's 75BT truck crane gives you a specially designed, heavy-duty chassis for mobility and speed with full 40,000 lb. lifting capacity . . . Folding boom for easier handling in heavy traffic . . . High gantry, optional fluid coupling to absorb shock loads and power load lowering can't be beat for smooth, precision work! . . . Power actuated mechanical drum clutches, exclusive right angle drive, conical hook rollers and many other operating advantages for faster, easier work . . . The 75BT truck crane is quickly convertible to all attachments including the new, exclusive, profit-making Gar Wood Foundation Borer — the machine that bores and bells in one fast operation . . . Get details from your dealer—

TWO CRAWLER MOUNTED CRANES!

Standard-duty 75A and heavy-duty 75B models. With 35 ft. boom on 12 ft. radius a 75A lifts 16,500 lbs. and a 75B, 21,200 lbs. . . . Both are easily convertible *in the field!*



GAR WOOD GW TRADE MARK INDUSTRIES

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NEWS

Dividends higher than earnings for second year

For the second year, the total annual dividend paid by the Columbia Gas Systems Inc. will exceed the year's earnings, according to the report of the board of directors.

In making the announcement, Stuart M. Crocker, chairman, said "In both years, earnings have been depressed because of delays encountered in obtaining from regulatory commissions rate increases sufficient to offset increasing costs, which are largely gas purchase costs already granted by the Federal Power Commission."

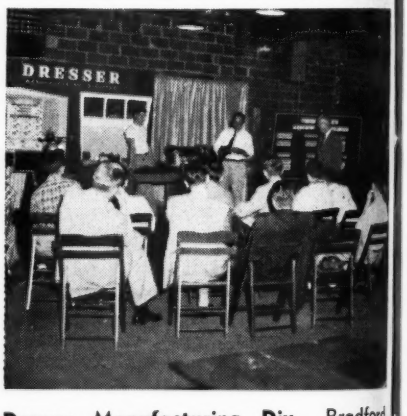
The directors believe that fairness to those who have invested their savings in Columbia's common stock requires that every effort be made to maintain their present annual dividend without reduction.

"Many men and women who use their savings to buy securities in public utility companies . . . do so because they know that such companies are regulated as to fair and reasonable rates by state and federal regulatory commissions," Mr. Crocker said. Accordingly, he continued, they properly believe that such regulation will assure them, as investors, a fair and reasonable return on their investment.

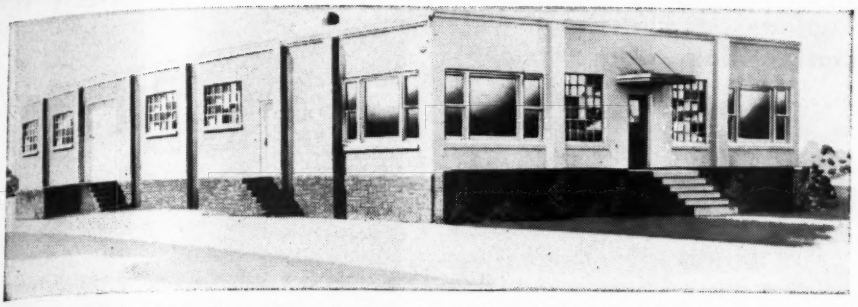
Portland Gas takes second "Oscar of Industry" award

For the second consecutive year, Portland (Ore.) Gas & Coke Co. has been judged to have the best annual report among the 47 gas companies vying in the annual contest conducted by *Financial World* magazine.

Portland President C. H. Gueffroy ac-



Dresser Manufacturing Div., Bradford, Pa., recently held a two-day training school for 18 cadet engineers of the Manufacturers Light & Heat Co., Pittsburgh. Included in the school were talks on the installation and maintenance of gas mains and services, an explanation and demonstration of Dresser products, a tour of the plant, and two movies, "Clamping Procedures," and "Bridge River Installation."



American Meter Co.'s Canadian subsidiary, Canadian Meter Co. Ltd., has constructed a new building in Edmonton, Alberta, to house the greatly expanded activities of the company. The new facilities will provide a meter-run fabrication department and repair shops for displacement meters, orifice meters, and control instruments as well as space for warehousing the company's complete line.

and general manager of the sponsoring company, said. "The air conditioning industry will stand or fall on its ability to prove that operating costs are low enough to justify year-round air conditioning in houses costing less than $15,000," he said.

To reduce the cooling load and still retain features desired by the home-buying public, the design of the home specifies a well-ventilated attic and a low pitched roof surfaced with heat-reflecting marble chips. Special attention was paid to wall and ceiling insulation and to the vapor seal beneath the floating slab floor and around the perimeter of the house. Two small exhaust fans located in the kitchen dispel heat from cooking and food storage appliances.

cepted the bronze "Oscar of Industry" trophy at the 13th annual awards banquet held at the Hotel Statler in New York on Oct. 26.

Runner-up for top honors in the gas classification was Consolidated Natural Gas Co., New York, placing second; Equitable Gas Co., Pittsburgh, took third place.

August appliance shipments down, but up for year

Shipments of gas fired heating equipment and ranges were down during August (2.2% and 5.7% respectively) although for the year they both showed increases. During the eight-month period ending in August, manufacturers shipped 469,826 furnaces, boilers and conversion burners compared with 422,500 during the comparable months of last year.

August shipments of ranges are estimated at 168,500; 178,600 were shipped in August 1952. For the year to date, however, 1,431,400 units were shipped, a 4.4% gain over a like period last year.

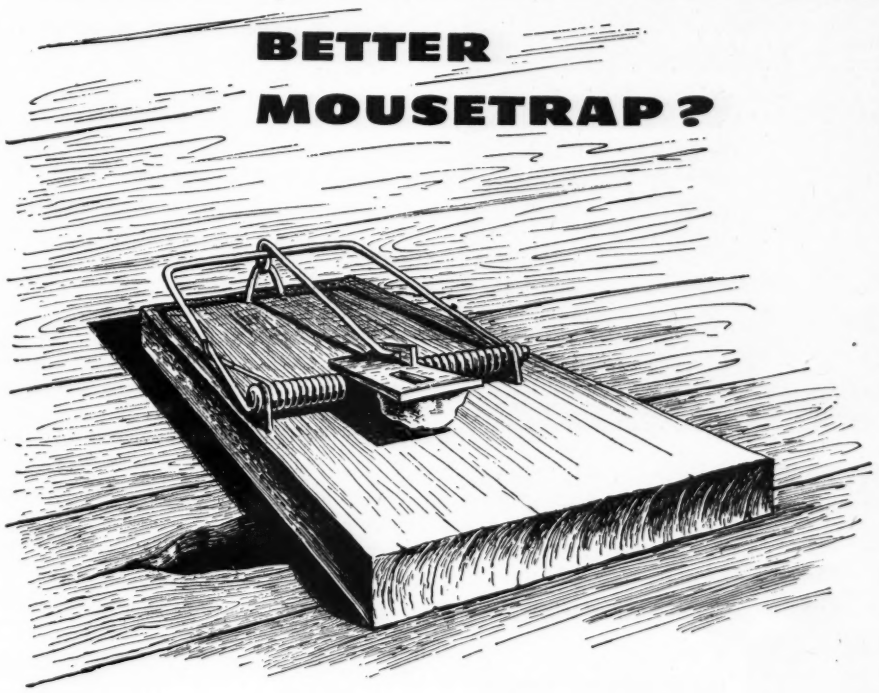
Although water heater shipments were up 1.2% in August, this was the lowest month of the year. For the year, 1,471,200 units are estimated to have been shipped, a 21.8% gain over last year.

Air conditioning to be tested in private home

A private home in Fort Worth, Texas, will serve as a unique laboratory for the next 12 months while electronic devices scientifically measure the cost of operating air conditioning equipment under actual day-to-day living conditions.

Sponsored by the Coleman Co., Wichita, the house is equipped with a combination heating and cooling system which operates with a new type water-saving evaporative condenser. Special instruments automatically record temperature and humidity conditions both inside and outside of the house. Gas, water, and electricity for year-around air conditioning will be recorded on separate meters.

The tests are part of a major campaign to replace "guesstimates" with facts about operating costs, Sheldon Coleman, president



The story of the reward for a better mousetrap is proverbial. But the fact remains that most mice are still caught by this simple, economical and effective contraption.

Gas purification is a parallel case.

Iron Sponge, preferred for the removal of H_2S seventy-five years ago, is still preferred today. And for these same reasons . . . simplicity, economy and effectiveness.

Iron Sponge operates with high efficiency at high or low pressures, has excellent capacity and activity, gives long service between foulings and is simply and quickly regenerated.

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A LIQUEFIED PETROLEUM GAS OF HIGHEST QUALITY
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Complete CORROSION PROTECTION Service
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436 Douglas Blvd. Los Angeles 12, Calif.

Laclede letter-writing contest has 2000 entries

Laclede Gas Co., St. Louis, recently asked its customers to write a letter on "Why I like to cook with natural gas," "Why I prefer natural gas for water heating," or "Why natural gas is better for clothes drying," and more than 2000 women responded.

From the 2000 letters, Laclede selected 100 as the best, and the authors were guests of the company at a luncheon with Liberace, well-known television star who was the star of Laclede's summer TV show.

Laclede has announced that the Liberace television program will continue on an every-other-week basis during the winter.

Liberace presents orchids to the youngest winner in the Laclede contest.

AGA-Servel refrigerator sales winners announced

Winners in the gas refrigerator sales campaign jointly sponsored by AGA and Servel were honored at the AGA convention last month with presentations of weather-clock trophies. The campaign covered three months—June, July, and August—with three classes of competition—retail, multiple housing, and total sales.

Retail winners in their divisions were Northern Indiana Public Service Co., Hammond; Southern Union Gas Co., Dallas; Central Indiana Gas Co., Muncie; Central Illinois Light Co., Springfield; Chattanooga (Tenn.) Gas Co.; Union Gas System Inc., Coffeyville, Kan.; Central Florida Gas Corp., Winter Haven.

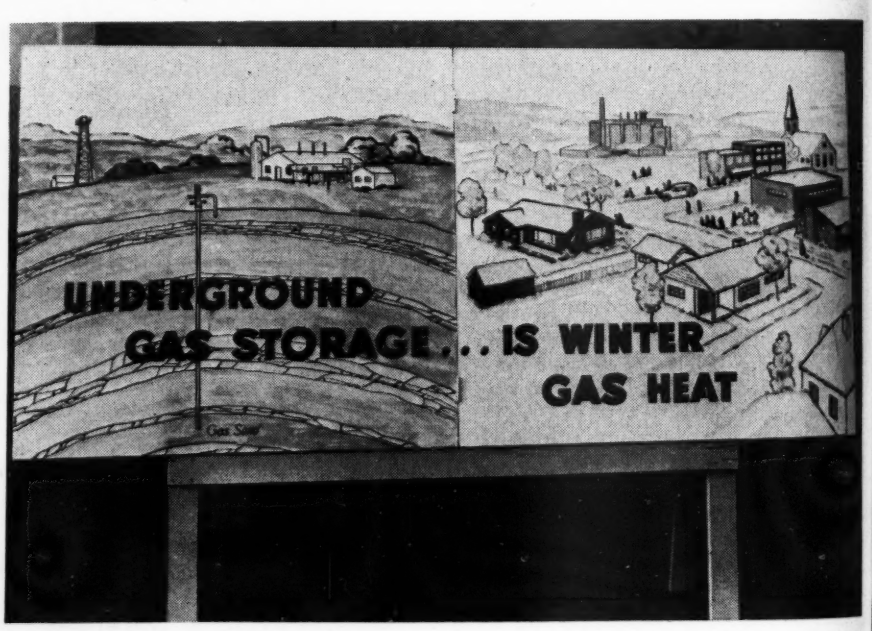
Multiple housing winners: Boston (Mass.) Consolidated Gas Co.; Alabama Gas Corp., Birmingham; and Metropolitan Utilities District, Omaha.

Companies with the greatest total sales of gas refrigerators, including both retail and multiple housing sales were Southern California Gas Co., Los Angeles; Houston (Texas) Natural Gas Corp.; and South Jersey Gas Co., Atlantic City.

For the best gas refrigerator sales promotion program of an non-merchandising utility, special recognition was awarded to the Manufacturers Light & Heat Co., Pittsburgh.

Servel is now in the midst of a water heater sales campaign, this one for sales managers and salesmen of Servel's distributor companies. Emil Nensel, sales manager of the company's water heater division, has announced a "Sugar Bowl Bound" contest based on the sale and delivery of Servel's full line of gas and electric water heaters to dealers.

Ten winners and their wives will be given an all-expense-paid trip to New Orleans



The vital role that underground gas storage plays in making gas service available to householding customers is being demonstrated visually by the Pennsylvania Natural Gas Men's Assn. with a specially designed full-color water color painting. The 6-ft by 3½-ft poster is now touring United Natural Gas Co.'s commercial offices and will then be available for similar use by other member companies.

over the New Year's week-end, with a New Year's eve party at one of the leading hotels, two tickets to the Sugar Bowl football game, and sightseeing tours. Savings bond awards will be given to runners-up.

Utility gas sales up 10.5% in August

An increase of 10.5% in utility gas sales was shown for the year ending Aug. 31, 1953, compared to the same period last year. Sales for the 8-month period totaled 55,694 million therms.

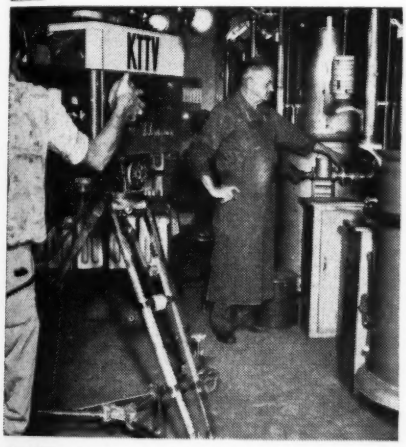
For the month of August, sales to ultimate customers totaled 3487 million therms, a gain of 2.9% over sales of 3389 million in August last year. The AGA's August index of total gas utility sales is 158.5% of the 1947-1949 average.

Natural gas sales, totaling 3315 million therms in August, were up 2.9% over last August, while manufactured and mixed gas sales, totaling 172 million, were down 3.5%.

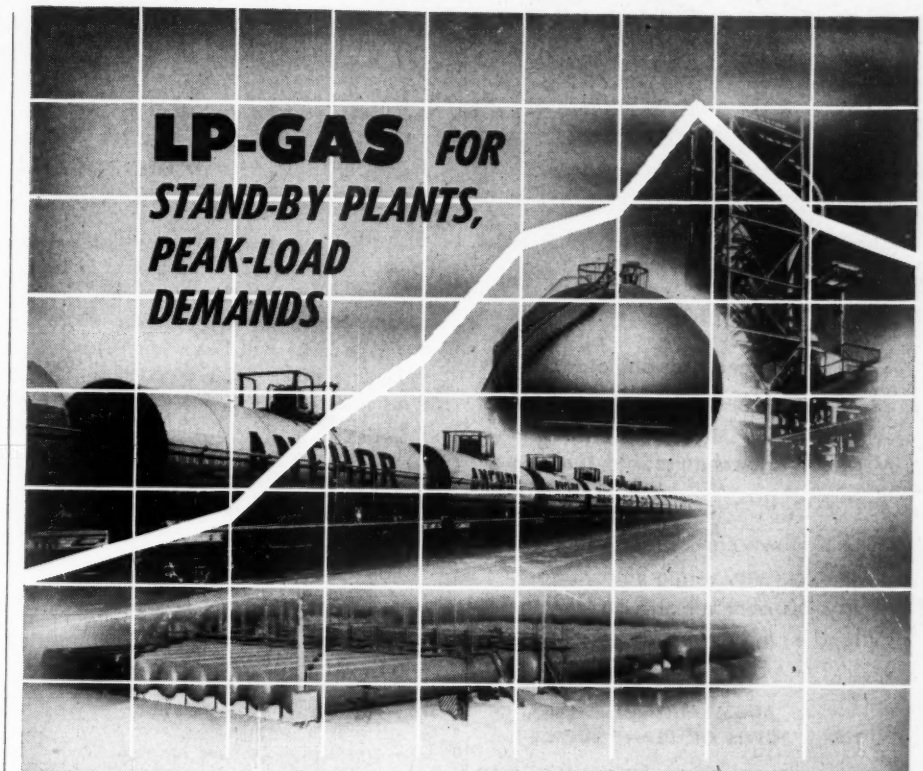
Progas of Canada to build portable gas plants

As the result of an agreement entered into with California Standard Co., Canadian Gulf Oil Co., and others, the first portable gas processing plants ever to be constructed in western Canada will be built within the next few months by Canadian Palmer Stendel Oil Corp., which plans to change its name to Progas of Canada Inc.

One portable plant will be built on the Acheson field near Edmonton and another on the property of Canadian Gulf, between



Operation of a meter prover in the Southern Counties Gas Co. meter shop in Los Angeles was explained to viewers of the popular television program, "Success Story," recently. The show, which takes viewers behind the scenes of a selected southern California industry each week, devoted one program to a tour of the company's Triggs Street facilities and an explanation of service functions of both Southern Counties and Southern California Gas Co. (For other use of television by the industry, see page 31.)



Industrial Plants, Cities:

When dependability of LP-Gas supply is the important factor in choosing the supplier, look to Anchor. Anchor has the tank car fleet, the transportation knowledge and the sources to take care of your needs. Anchor's offices are located to give nation-wide service. So, before making contracts, Call Anchor First.

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A "MUST" in Homes with Automatic Heat
A FULL-PROFIT LINE • NO TRADE-INS
INCINOR IS APPROVED BY A.G.A. LABORATORIES
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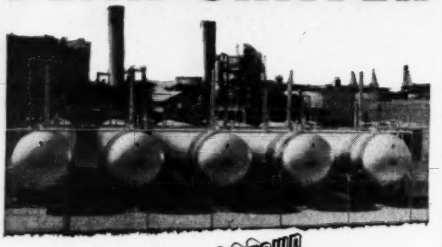
PEAK SHAVER



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This packaged propane plant designed, engineered and built by Draketown, provides a completely interchangeable fuel for natural gas.

Draketown can design and build one for you, *within your budget,* to take over all or part of your load at the turn of a valve.

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On your next business trip, make the PITTSBURGHER your headquarters. 400 outside rooms . . . bath . . . radio . . . circulating ice water . . . television. Air conditioned dining rooms, function rooms and sleeping rooms. Garage service.

a Knott Hotel

JOSEPH F. DUDDY, MANAGER
ATlantic 1-6970

Edmonton and Calgary. It is planned to have the latter plant in operation within six months and the Acheson plant by next June.

Anchor plans underground L.P. gas storage in East

What is believed to be the first L. P. gas underground storage well project in the East is planned by Anchor Petroleum Co. near Bath, N. Y. Drilling for the 50,000-bbl storage cavity will begin immediately, with the first storage well expected to be completed early next year. According to Anchor President W. A. Baden, two other wells of the same size are planned.

L. P. gas is already available from underground storage plants in Hattiesburg, Miss., and Midland, Texas. The capacity of Anchor's Hattiesburg storage will soon be up to 16 million gals. and Midland will ultimately provide storage for 20 million.

Revenues up 21.8% for July '52-'53 period

Operating revenues of natural gas companies reporting to the FPC totaled $150,705,834 in July 1953, a 27.4% increase over the $118,337,714 in July 1952. For the 12-month period ending the last of July, revenues aggregated $2,196,758,079, 21.8% higher than the similar period in 1952.

Sales to residential, commercial, and industrial consumers increased 5.0%, 6.9%, and 19.8%, respectively, while revenues from the three classes of service increased 11.1%, 14.0%, and 32.8%, respectively. Revenues from all sales to ultimate consumers increased 23.4%, amounting to $58,918,582.

All-gas home featured in Parents' Magazine project

Parents' Magazine's newest home for families with growing children, built in Park Forest, Ill., a Chicago suburb, is an all-gas home, with gas used for cooking, refrigeration, water heating, and space heating.

The home, which was developed by American Community Builders Inc., features perimeter heating, providing a combination of floor radiant and convection heat, in the form of a Luxaire counter-flow automatic gas heating plant manufactured by C. A. Olsen Manufacturing Co.; a Magic Chef range with two ovens; a Servel automatic gas Ice Maker refrigerator; and a 40-gal. Rheem automatic gas water heater.

News Notes

The United Gas research lab, Shreveport, has placed an order with Consolidated Engineering Corp., Pasadena, Calif., for a mass spectrometer, which will be used for routine gas analysis. The spectrometer will also be used in many liquid analyses and in connection with research projects having to do with reservoir phase behavior studies.

Pardon us, but your sleep is showing
• Never a heating care in the world . . . day or night . . . with Natural Gas.
• An automatic, thermostatically controlled gas heating system does all the worrying about temperature changes . . . inside or out . . . and lets you sleep a full night through—to awaken refreshed.
• Goodbye forever to evening and morning trips to the basement to bank the fire or kindle 'er up to warm a cold house.
• Gas is always on the job . . . no watching, no work . . . clean, convenient and mighty economical.
• Yes . . . you rest easier—and more—with gas heat in the house!
WONDERFUL WAY TO START THE DAY
Abundant gas-heated water!
Greeley Gas Co.

In the Advertising Assn. of the West's 1953 annual competition among 1300 advertisers and advertising agencies in the 11 western states, Greeley (Colo.) Gas Co. placed third for excellence in newspaper advertising with the ad reproduced above, proving that even a small utility can be big in the field of advertising and public relations.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., has just announced the availability of its new Y400 Powerpile systems, which offer complete gas heating control, independent of any outside power supply.

Upon public service commission approval, Southern Union Gas Co. will take over the operation of the Sacramento Gas Co. of Alamogordo, N. M. An immediate investment of $20,000 in new supply lines is planned.

Gunderson-Taylor Machinery Co. has moved into new and larger quarters in Denver. The move was necessitated by the company's expansion since its incorporation in 1946: 17,000 sq ft of space is required to house it whereas only 1500 was needed seven years ago. The new location features 5000 sq ft of yard space for housing the company's rental fleet.

Among the 34 Delaware Valley firms who were cited recently for their part in helping educate more than 5000 Drexel Institute of Technology graduates were the Philadelphia

Electric Co., Brown Instruments Division of Minneapolis-Honeywell Regulator Co., Allied Chemical & Dye Corp., and the Philadelphia Gas Works. The companies received Citations for Service to Higher Education from Dr. Robert C. Disque, retiring Drexel dean.

Detroit Brass & Malleable Co. has announced a $500,000 expansion and improvement program to increase the company's capacity of its brass products plant in Detroit. The announcement was made by President Charles Wiener, who stated that commitments have already been made for new foundry facilities and equipment and that the project, which will involve plant-wide improvements and the installation of new machinery, will be completed early next year.

A new line of automatic gas water heaters has been added to Utility Appliance Corp.'s present lines of furnaces, heaters, ranges, and other gas-fired products. The water heaters will be distributed to the plumbing trade through regular wholesale channels. Forrest L. Line has been named director of the sales for the Los Angeles company's new division.

Reeves Brothers Inc., New York textile manufacturers, has announced the purchase of Vulcan Rubber Products Corp., Brooklyn, and Duroflex Inc., Buena Vista, Va., both producers of industrial coated fabrics. All assets, properties, machinery, and trade names will come under Reeves ownership and management. Officers of the new subsidiary are John M. Reeves, president; C. E. Hemes, of Duroflex, vice president and general manager; Dale J. McKnight, sales manager.

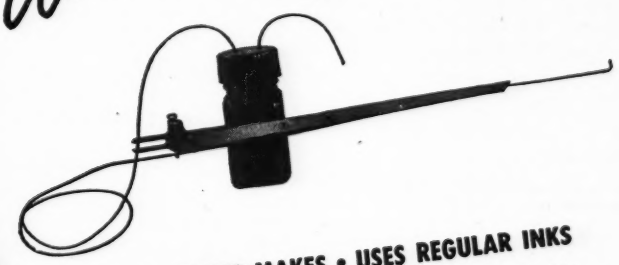
Complete production equipment, patents, engineering drawings, etc., of the Solenoid Valve Div. of Wheaton Engineering Co. have been purchased by Eclipse Fuel Engi-

Holding the ball for the kickoff of Detroit-Michigan Stove Co.'s three-month sales contest is Paul Inskeep, director of sales. The "3-D Sellerama" is being conducted in key radio and TV areas among retail salesmen. Top salesmen in each area will win an all-expense-paid weekend in Miami Beach.

ARCCO

ARCCO NEVER-DRY PEN

Writes for Months



REPLACES OTHER MAKES • USES REGULAR INKS

Regardless of pulsations or other causes of ink failures this new Never-Dry Pen will make clean and complete records. Ink supply lasts for several months without refilling reservoir. Capillary tube from ink bottle placed in instrument case feeds pen with continuous flow. Closed system sealed from atmosphere prevents clogging and dirt accumulation.

Weight of pen is constant at all times thus insuring extreme accuracy. No slopping or dripping. Stainless steel construction—no corrosion. When ordering, specify make and type of recording instrument.

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Send for quantity prices

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New York 4, N. Y.....80 Broad Street
Kansas City 6, Mo.....1006 Grand Ave.
Dallas 4, Texas.....3200 Maple Ave.

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Pipe Sizes 2" thru 24"

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Denver 2, Colo.....1921 Blake Street
Los Angeles 48, Cal.....6399 Wilshire Blvd.
San Francisco 4, Cal.....235 Montgomery St.
Portland 4, Ore.....501 Portland Trust Bldg.
Salt Lake City.....Waterworks Equip't Co.
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NORWALK RELIEF VALVES

- **Large Capacity But only opens enough to prevent excessive pressures.**
- **Gives Tight Shut Off when pressure is normal.**
- **Easily set to relief at any desired pressure.**
- **Available in several models for varying conditions.**

IN SIZES UP TO 20"

NORWALK VALVE COMPANY
Railroad Ave.
South Norwalk, Connecticut
Manufacturers of Check Valves and Gas Pressure Regulators Since 1878

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GAS LEAK LOCATION SURVEY

Developed Specifically for Commercial and Industrial Areas

WRITE . . .
WIRE . . .
OR PHONE

HEATH
SURVEY CONSULTANTS, INC.
WELLESLEY, MASS. RICHMOND, MICH.
"You Can't Sell Gas That Leaked Out"

neering Co., Rockford, Ill. Production of the solenoid valves began in Rockford early last month.

The Rocky Mountain Gas Equipment Co. has been organized in Denver to manufacture a new, improved safety pilot burner for furnaces, water heaters, and other gas appliances. Dick W. Tanner is president of the new firm, and Paul J. Patch, who invented the draft-proof pilot burner, is a director.

The first of 700 homes in Broadmoor, the nation's largest air conditioned housing project, was opened recently in connection with the kickoff of National Home Week. Each all-gas house in the Little Rock, Ark. development is being built around year-round air conditioning. Two-ton units, which are designed to meet demands for air conditioning in the middle-income range, are being installed by Servel Inc. in cooperation with the Arkansas Louisiana Gas Co.

J. P. Glasby Manufacturing Co., Belleville, N. J., has started construction on the new section of its plant, which will add 8000 sq ft to executive, manufacturing, and assembly departments.

More than 10 million customer contacts and more than 700,000 phone calls were made by the home economics staffs of the nation's gas companies in the past year. A study by GAMA shows the number of utility-employed home economists has increased 20% in each of the past two years with more than 2000 trained homemakers now employed.

Natural gas common stock prices continue to decline slightly, with the price of the composite index of 30 companies compiled by AGA about 1.2% lower on Sept. 25 than on the comparable date a year earlier. Natural gas transmission stocks declined 2.2%, while the price of common stocks of distributing companies was down 1.3%. Yields on stocks of natural gas companies increased 7.9% as of the end of September compared to September 1952.

Pacific Gas & Electric Co., San Francisco, will increase the supply of natural gas stored underground at Modesto for use in the Modesto-Turlock area by 50% this winter. Work is now in progress on a $162,000 expansion of the present underground holder, which consists of 3½ miles of 34-in. high pressure pipe buried in 1025-ft lengths. Capacity of the holder will be increased from 3 to 4½ MMcf of gas.

Subject to approval by the New York Public Service Commission and the SEC, Long Island Lighting Co., Mineola, plans to offer new common shares to shareholders and employees. Shareholders will be offered 685,648 new shares in the ratio of one new share for each seven held. The company plans to offer 100,000 new shares to employees under nontransferable subscription privileges.

People

Promotions

J. E. Heyke
Brooklyn Union

William Rodgers
Blaw-Knox

JOHN E. HEYKE JR. has been elected president of the Brooklyn (N. Y.) Union Gas Co., succeeding the late Hugh H. Cuthrell. Mr. Heyke joined BU in 1933, serving as assistant vice president, vice president, and executive vice president.

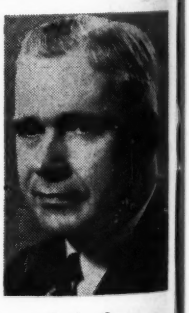
WILLIAM RODGERS, who has been general sales manager since April, has been elected vice president and general sales manager of Blaw-Knox Co., Pittsburgh.

Several appointments have been announced by Servel Inc., Evansville, Ind. THEODORE W. RUNDELL, vice president in charge of engineering since 1952, is now vice president in charge of operations; G. HOWARD CHRISTINE, former contract sales representative, is manager of the contract sales division; J. R. LUMPKIN is appliance sales manager in Miami; FRANK D. O'SULLIVAN is manager in Philadelphia; EARLY CUNNINGHAM in Albany, N. Y.; and C. SIDNEY JOHNSTON JR. in Milwaukee.

JOSEPH A. CERNY has been promoted to manager of the sales and engineering information section of Bryant Heater Div., Affiliated Gas Equipment Inc., Cleveland. PAUL J. SCHAACK succeeds him as Cleveland branch sales manager.

The following officers have been elected by Refining Supply Co., Tulsa; W. A. SCHLUETER, chairman; J. T. GOSSETT, president; LEO T. NORVILLE, secretary; W. J. LUBY, treasurer; J. B. OKESON and T. C. WILLIAMS, vice presidents; LOUIS L. DENT, R. K. DI VALL, and ROGER S. RANDOLPH,

P. J. Schaack



J. A. Cerny
Bryant Heater

Now...

NEW AQUA ENGINEERED DESIGN

reduces needle spinning to an absolute minimum by the introduction of subsidiary magnetic fields which create a powerful electric "braking" action. PINPOINT ACCURACY WITH GREATER SPEED — fewer man hours on every job!

"... after a month of field testing in every type of soil and under all weather conditions, our men report that your new Aqua locator is so greatly improved there is simply no comparison with the previous model ... no needle nervousness ... pinpoint accuracy. It has our unqualified approval!"

W. F. Becker

W. F. Becker
Chief Inspector
The Ohio Fuel Gas Co.
Columbus, Ohio

ACTUAL IMPARTIAL FIELD TESTS PROVE THAT AQUA OUT-PERFORMS COMPETITIVE INSTRUMENTS!

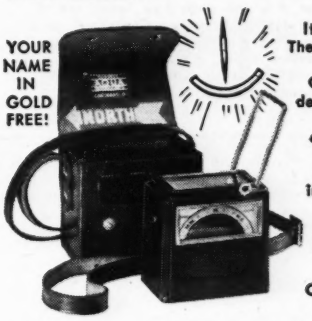
15-DAY FREE TRIAL

ORDER TODAY • SEND NO MONEY

FOR QUICKER, SURER LOCATIONS EVERYTIME

THE *New* AQUA VALVE BOX LOCATOR

New engineering design, perfected after two years of research and now built into the AQUA at no additional cost to you MEANS ABSOLUTE MINIMUM OF NEEDLE-SPINNING ACTION!



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FOR SALE: One Long Horn Trencher with 12" cutting buckets in excellent location. Available for immediate delivery. Contact Modern Welding Company, P.O. Box 5008, Tulsa 16, Oklahoma, or Modern Welding Company, P.O. Box 528, Owensboro, Kentucky.

SALES REPRESENTATIVE desires factory territory, mid-south, preferably Memphis area. Thirty-six years old, 9 years with major gas appliance manufacturer. Write Box 75, GAS, 198 S. Alvarado St., Los Angeles 57, Calif.

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ONE MAN OPERATION
METAL CABINETS
HEAVY DUTY PERFORMANCE
ONLY
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PALO ALTO, CALIFORNIA

assistant secretaries; and L. MASBRUCH, assistant treasurer and assistant secretary.

CLAIR S. REED has been elected vice president, director and a member of the executive committee of the United Metal Craft Co., Ypsilanti, Mich., a subsidiary of Gar Wood Industries Inc.

STEPHEN C. BIXBY has been named operations manager of the new Appliance Controls Div. plant of Minneapolis-Honeywell Regulator Co. in Gardena, Calif. He was formerly chief of mechanical design for the Honeywell Heating Controls Div. in Minneapolis.

J. CURRAN FREEMAN has been appointed to the office of controller of Dresser Industries Inc., Dallas.

MILTON V. STAGG, assistant to the vice president of the Williams Div. of the Eureka Williams Corp., Bloomington, Ill., has retired. He joined the company in 1934 as manager of the Williams Ice-O-Matic Div. and for the past year and a half has acted as an independent company consultant on matters of company policy relative to the Williams division.

M. V. Stagg
Eureka-Williams

J. E. Lindsay
National Radiator

JOSEPH E. LINDSAY, formerly research engineer, has been promoted to the post of assistant manager of the engineering service department of the National Radiator Co., Johnstown, Pa. The company has also announced that GERALD R. COX is now sales representative in northern California and Nevada for the company's heating products.

WALTER B. CLAUS has been made director of manufacturing of Consolidated Engineering Corp.'s newly reorganized transducer division. The Pasadena, Calif. company has named GERALD S. PERKINS to succeed him as chief mechanical engineer.

GUY C. MILLER has been named traffic manager of Anchor Petroleum Co., Tulsa.

RALPH T. MCELVENNY has been named to succeed HENRY FINK as president of American Natural Gas Co., New York. Mr. Fink, who has been president and a director of American Natural since 1948, will continue to serve as president of Michigan Wisconsin Pipe Line Co., American Louisiana Pipe Line Co., and American Natural Gas Service Co., and chairman of the board of Michigan Consolidated Gas Co. Mr. McElvenny is also an officer in these companies.

W. H. DREAPER has retired as gas superintendent of the B. C. Electric Co. Ltd., Victoria, B. C., after more than 43 years of service.

DARWIN WHIPKEY, a 12-year veteran with New York State Natural Gas Corp., Pittsburgh, has been appointed safety director for the company.

JOHN J. JACOB JR., president of Peoples Natural Gas Co., Pittsburgh, has been elected a director of Consolidated Natural Gas Co., the parent company.

RALPH H. TAPSCOTT, chairman of the board of trustees of Consolidated Edison Co. of New York, retired from that office in September, after 36 years of active service with ConEd. He will continue to serve as a member of the board, to which he was first elected in 1937. Mr. Tapscott became chairman in 1949 after he had served 12 years as president. He was named chief executive officer in 1942, a post he relinquished early this year.

United Natural Gas Co., Oil City, Pa., has announced the following appointments: J. G. MONTGOMERY JR. to executive vice president; HARRY B. WOOD and JOHN A. COMET, vice presidents and directors; HOWARD C. ROSE, secretary-treasurer and director, succeeding MERTON J. TALLEY, who retired last month; and LAWRENCE J. FLECKENSTEIN, assistant treasurer, following the retirement of J. F. MULLINS.

The following promotions have been announced by the Washington (D. C.) Gas Light Co.: HOWARD B. NOYES to senior vice president; OTIS H. RITENOUR to vice president, finance; DONALD S. BITTINGER to vice president, operations; WYLIE W. BARROW to treasurer; C. OSCAR BERRY to general counsel; and RICHARD H. BUSSARD to manager, purchasing and stores department.

HARRY L. MCANALLY has been appointed assistant land department head of Peoples Natural Gas Co., Pittsburgh.

DR. RAYMOND W. MCNAMEE has been promoted to the post of manager of research administration of Union Carbide & Carbon Corp., New York. DR. FRANKLIN JOHNSTON succeeds him as superintendent of the research and development department at South Charleston, W. Va.

COL. WILLARD F. ROCKWELL, who has resigned as assistant to Secretary of Defense Wilson, has returned to his position as chairman of the board of directors of Rockwell Manufacturing Co. Colonel Rockwell had been with the Defense Department since last

W. F. Rockwell
Rockwell Mfg.

J. T. Young
American Meter

April. At the time of his resignation, he had just completed his third tour for the department this year, this time inspecting principal sources of munitions supply for the NATO nations.

New faces

JOHN T. YOUNG has joined Canadian Meter Co. Ltd., Canadian division of American Meter Co., as sales representative for the western division. He will handle sales and service for the western division, south Alberta and Saskatchewan sales territories from Calgary.

New members of the Columbia Gas System legal staff include ARTHUR BATTEN, former Detroit attorney, who will handle matters pertaining to gas heating restrictions, and JOHN P. RANDOLPH, formerly general solicitor of the National Assn. of Railroad & Utilities Commissioners, who has become an associate counsel for the Columbia service corporation with offices in Washington, D. C. KARL SHAVER, chief of branch in the division of public utilities of the SEC, has joined Columbia's treasury department.

A. B. BANOWSKY has joined Southern Furnace & Supply Inc., Houston, as executive vice president. His former affiliations include Payne Furnace Co. and United Gas Corp. The company also announces the promotion of BOB ELDER to secretary and treasurer. He was formerly office and credit manager.

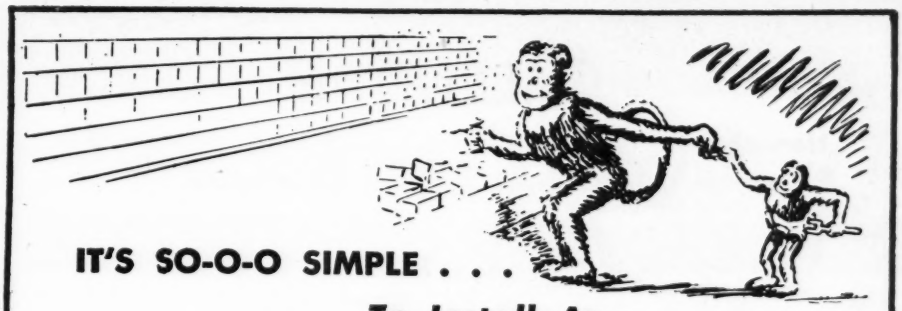
THEODORE E. BURLEIGH has joined the National Research Corp., Cambridge, Mass., as a sales engineer.

M. R. WINGARD and E. P. ADDITON have joined the Chemical Plants Div. of Blaw-Knox Co. as sales engineers in the Tulsa and Pittsburgh offices, respectively.

Transfers

H. WAYNE THOMPSON is the new manager of the South Carolina properties, which include Aiken and North Augusta, for Atlanta (Ga.) Gas Light Co. He was formerly manager of the Bangor (Maine) division of Citizens Utilities Co.

JUDSON J. WEHMAN has joined the Ohio Gas Co. as sales manager with headquarters in Bryan, Ohio. Formerly with Ohio Fuel Gas Co., Mr. Wehman succeeds BERNARD



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The Insulator You Have Been Searching For!

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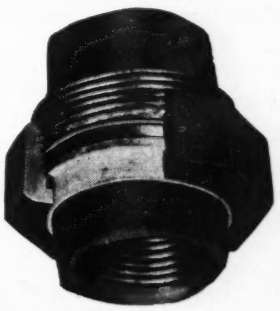
- 300# W. O. G.
- Will Not Break
- All Insulating Parts in Compression
- No Field Education Required
- Electrically and Pressure Tested

Sizes ½" - 3" Inclusive



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COMPANY_____

NAME_____ POSITION_____

STREET CITY ZONE STATE

CALENDAR

November

5..NEGA Safety Conference — Hotel Statler, Boston.

6..SGA Residential Sales East Conference — W. R. Barringer Hotel, Charlotte, N. C.

9-13..API — Conrad Hilton and Palmer House, Chicago.

9-13..National Hotel Exposition — Kingsbridge Armory, New York.

10-13..School Food Service Assn. Annual Convention—Boston.

11..GAMA Hotel, Restaurant & Commercial Gas Equipment Div.—Biltmore Hotel, New York.

11-13..Wisconsin Utilities Assn. — Hotel Schroeder, Milwaukee.

13..SGA Residential Sales West Conference — Adolphus Hotel, Dallas.

17-20..NACE Western Region Fall Conference — Biltmore Hotel, Los Angeles.

18-20..Mid Southeastern Gas Assn. Annual Meeting — Sir Walter Hotel, Raleigh, N. C.

29-4..American Society of Mechanical Engineers — Statler Hotel, New York.

30-2..SGA Advisory Council & Management Conference — Grand Hotel, Pt. Clear, Ala.

December

1-4..University of Oklahoma Corrosion Conference — University of Oklahoma, Norman.

9..NEGA Appliance Servicing Conference — Hotel Statler, Boston.

1954

January

14..SGA Air Conditioning Service Installation, East — Tutwiler Hotel, Birmingham, Ala.

14..NEGA Operating Division — Hotel Statler, Boston.

14-21..National Housewares & Home Appliance Exhibits — Navy Pier, Chicago.

15..SGA Air Conditioning Sales, East Conference — Tutwiler Hotel, Birmingham, Ala.

17-21..National Assn. of Home Builders 10th Annual Convention & Exposition—Chicago.

21..SGA Air Conditioning Service & Installation, West — Rice Hotel, Houston.

22..SGA Air Conditioning Sales, West Conference — Rice Hotel, Houston.

25-27..ASHVE 60th Annual Meeting — Rice Hotel, Houston.

March

4-5..AGA Transmission and Storage Conference — Jung Hotel, New Orleans.

15-17..Mid-West Gas Assn. Annual Meeting — Fort Des Moines Hotel, Des Moines, Iowa.

25-26..Oklahoma Utilities Assn. Annual Meeting — Biltmore Hotel, Oklahoma City.

25-26..New England Gas Assn. Annual Meeting — Hotel Statler, Boston.

April

12-14..AGA Sales Conference on Industrial & Commercial Gas — Edgewater Beach Hotel, Chicago.

12-14..National Conference of Electric & Gas Utility Accountants—Hotel Statler, Boston.

13-15..Oklahoma Utilities Assn. Southwestern Gas Measurement Short Course — University of Oklahoma, Norman.

20-23..AGA Distribution, Motor Vehicles, and Corrosion Conference—Mount Royal Hotel, Montreal, Canada.

22-23..Indiana Gas Assn. Annual Meeting — French Lick Springs Hotel, French Lick, Ind.

26-28..Mid-West Regional Gas Sales Conference — Edgewater Beach Hotel, Chicago.

26-28..Southern Gas Assn. Annual Convention—Houston.

May

10..AGA Commercial Gas School — Chicago.

9-12..LPGA Convention — Conrad Hilton Hotel, Chicago.

19-21..GAMA Annual Meeting — The Drake Hotel, Chicago.

24-26..AGA Production and Chemical Conference — William Penn Hotel, Pittsburgh.

27-28..Natural Gas & Petroleum Assn. of Canada — Prince Edward Hotel, Windsor, Ontario, Canada.

June

28-29..Michigan Gas Assn.—Grand Hotel, Mackinac Island, Mich.

C. PAUL, who has become sales manager of Michigan Gas Utilities Co., Coldwater, Mich.

Deaths

E. M. Borger

EDWARD M. BORGER, 52, who retired Sept. 1 as president of Peoples Natural Gas Co., chairman of the board of New York State Natural Gas Corp., and director of Consolidated Natural Gas Co., died Sept. 20. Following his admission to the bar, Mr. Borger was an attorney for Peoples, Hope Natural, and other subsidiary firms which were then a part of the Standard Oil Co. of New Jersey. He was general counsel for the same companies during 1935-40, and in 1940 was elected president, director, and manager of both Peoples and New York State. Active in both civic and industry affairs, Mr. Borger was a director and former president of the Pennsylvania Natural Gas Men's Assn., and a member of both the American Gas Assn. and the American Petroleum Institute.

H. N. NELSON, assistant sales manager of the Findlay division, Gar Wood Industries, Wayne, Mich., was killed Sept. 29 in an automobile accident. He was 43 years old.

LUCIEN W. MUELLER, board chairman of the Mueller Co., Decatur, Ill., died Oct. 6 after a 6-week illness. He was 58 years old. Mr. Mueller first became a member of the board in 1922; in 1928 he was named vice president in charge of engineering. He had been chairman of the board since 1947.

P. J. ERICKSON JR., 41, vice president and chief engineer of the Arkansas-Louisiana Gas Co., died Sept. 4 in Shreveport. He had assumed his positions in April, when Arkansas-Louisiana was separated from Arkansas Natural Gas Corp. He was formerly assistant manager of the rate and valuation department.

DANIEL S. KEENAN, president of the Carnegie Natural Gas Co., died in Pittsburgh in September. He had been with the U. S. Steel Corp. subsidiary for the last 15 years.

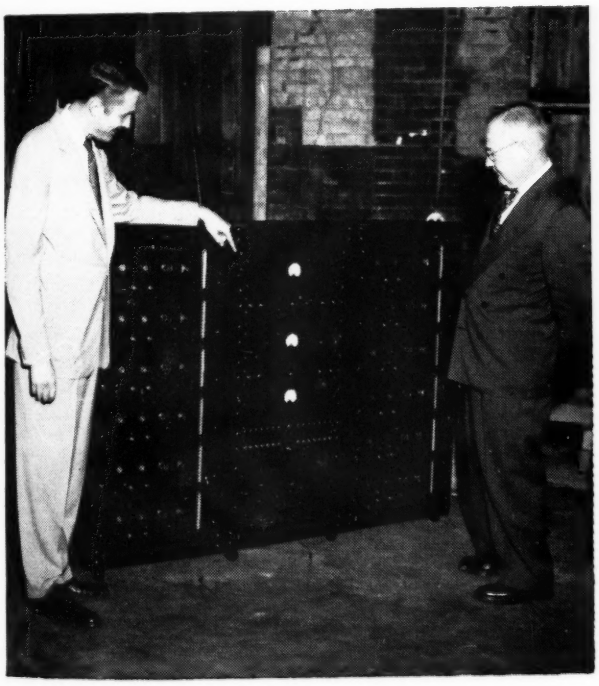
GEORGE MARTIN SHEPHERD, an authority on chemical and physical methods of gas analysis, died suddenly on Sept. 17, ending 32 years of service at the National Bureau of Standards. At NBS, Mr. Shepherd made important contributions to the development and standardization of methods for the analysis of gases.

GEORGE R. STEERE, New England sales representative for Semet-Solvay Engineering Div., Allied Chemical & Dye Corp., died recently after a brief illness.

GAS

Transmission and Conditioning Section

Setup for a crucial test

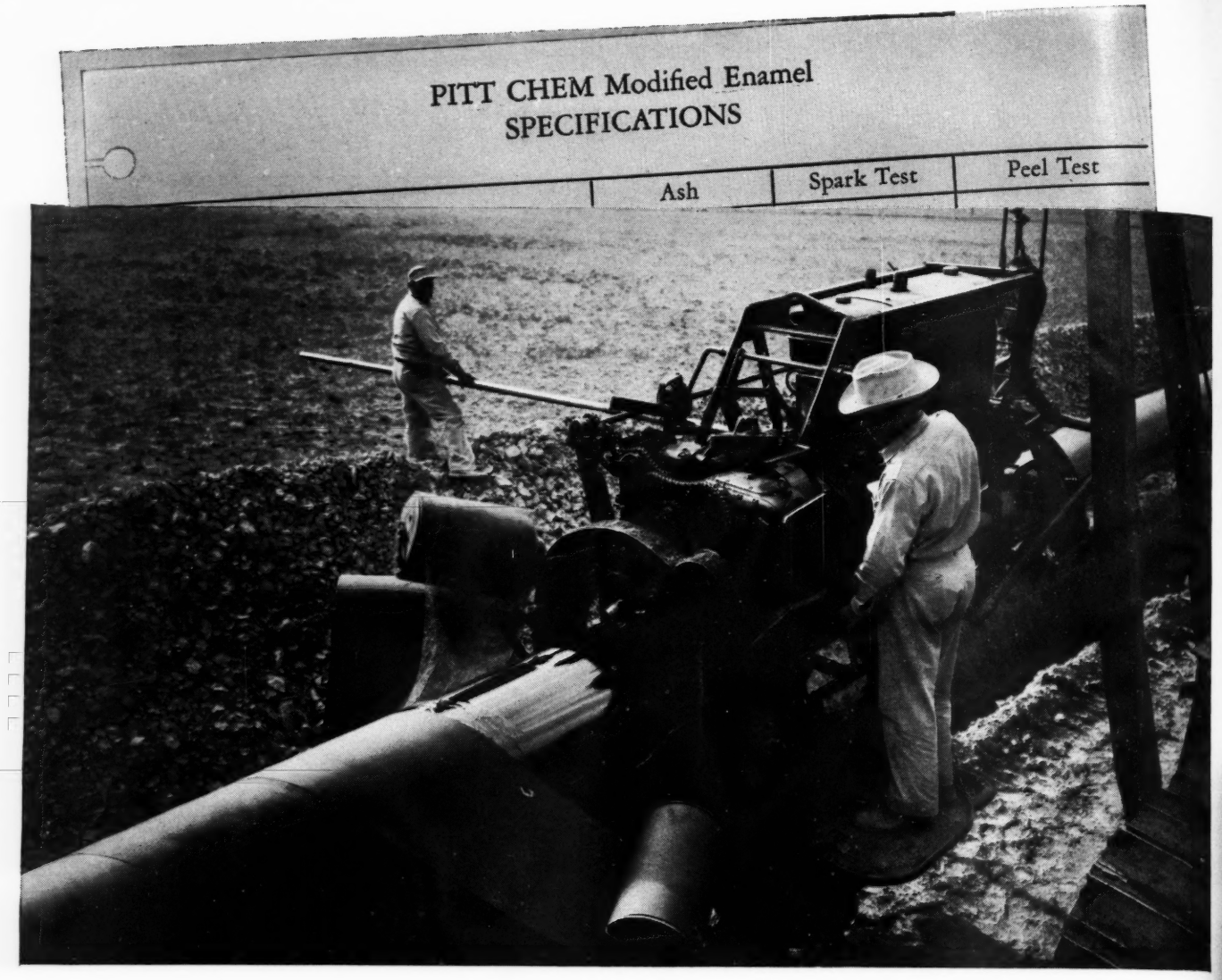


Near Athens, Ohio, not far from Columbus, preparations are rapidly going ahead at a test site for the widely publicized pipeline fracture tests, scheduled to begin in December. Special equipment has been devised to measure and record the velocity of induced failures in the test pipe.

Shown above is the general layout, with the test pit, where a 30-ft exposed joint of pipe will be inserted for the tests, in the foreground. The sandbagged structure in the rear will house measuring and recording equipment. Connecting wiring will be sheathed in the small-diameter pipe which spans the ditch. Behind the house is a compressor, and to the right is the blowdown stack.

At left, C. F. de Mey watches as George McClure points out features of the electronic counting equipment that will be used to measure the fracture velocity. The center section consists of power supply and 200,000-cycle per second oscillator, which drives all units. Six separate counters, each capable of counting up to 200,000 pulses per second, are located on each side of the unit. Each set of six counts the fracture rate in a single direction from the break.

For a brief, on-the-spot description of the test site, turn the page.



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Athens prepares for crucial fracture tests

By **FRANK CHAPMAN** • Feature Editor

SPECIALLY designed electronic equipment that will be used to measure pipe fracture velocity at the pending Athens (Ohio) AGA-sponsored test on pipeline steel has been completed and put into operation at Battelle Memorial Institute in Columbus.

The equipment, which consists of 12 separate counter units, will be used to accurately record the rate at which the artificially produced pipeline fracture takes place. Each of the 12 counters is operated from one of an equal number of wires cemented around the circumference of the test pipe section at measured intervals along its length. A time record is made by the bank of counters as the wires are successively broken by the fracture.

It is expected that initial tests will be made at Athens sometime in December. Tests are to be conducted on property owned by the Texas Eastern Transmission Corp. and carried out in conjunction with laboratory work now under way at Battelle.

Basically, the program involves subjecting pipe of various diameters to pressures normally used in transmitting natural gas over long distances. The pipe will be purposely damaged prior to the tests to cause it to fracture and artificial means will be used to initiate the break.

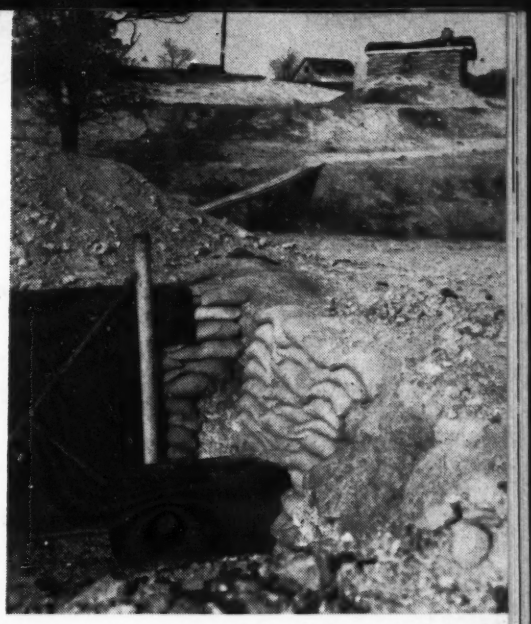
Data obtained in the tests will be used to help pipe manufacturers and pipeline operators improve the efficiency and safety of gas pipelines.

An industry group headed by C. F. de Mey, vice president and chief engineer of Columbia Gas System Service Corp., has charge of the tests. The group is known as the "Line Pipe Field and Laboratory Research Committee," and is a part of a subcommittee on gas transmission and distribution which was formed to develop a national standardized code for gas pipeline systems.

Project engineer for Battelle is George McClure of Columbus (see Pipeline cover), who is in direct charge of the project.

A 300-ft-long experimental pipeline has been laid in the ground at the Athens test site. Only a 30-ft center section will be fractured during the experiments. The entire length of the pipe except for the 30-ft center section is buried.

The test section will be coupled into the center of the 300-ft length with patented Weld+Ends couplers to minimize the possibility of a fracture carrying through a conventional weld and into the main section of the pipe. The Weld+Ends are screw-held type with internal neoprene rubber packings.



Close-up of one end of the buried 30-in. pipeline where the test section will be coupled.

The line will be pressurized with a 300-hp Clark skid-mounted MA-8 compressor. Gas is to be supplied from Texas Eastern's 30-in. mainline, which is adjacent to the test site.

The 12-channel electronic counter, designed especially for the test by Battelle engineers, counts at the rate of 200,000 pulses per second. The first wire broken by the fracture will cause the counting device to start. There will be two starting wires, one located on each side of the point in the center of the test pipe where the fracture will be initiated.

Additional wires will be located about 3 ft apart along the circumference of the pipe, both directions from the center. As the fracture travels through the pipe it breaks the wires successively and as each wire is broken the counter unit to which it is attached is stopped. In this manner the elapsed time between breaks can be accurately measured to produce a fracture velocity.

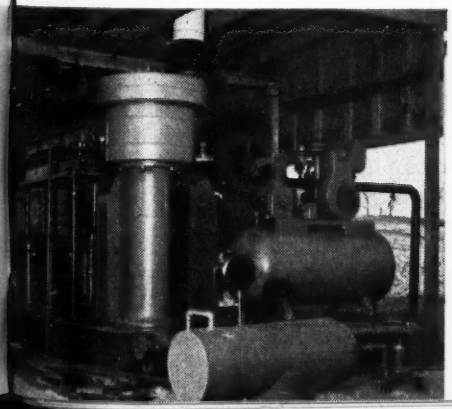
The wires cemented to the circumference of the pipe must necessarily be insulated from the pipe, and must be of such a material that a break will take place at the same instant that the pipe fractures.

The field fracture tests are primarily intended as a check against laboratory tests now in process at Battelle. If there is a satisfactory relationship between the two, field tests will be discontinued in favor of the less expensive laboratory work.

Pipe temperature will be carefully controlled during the tests. In addition to the fracture velocity measurement, stress measurements and a complete photographic record of the test will be taken.

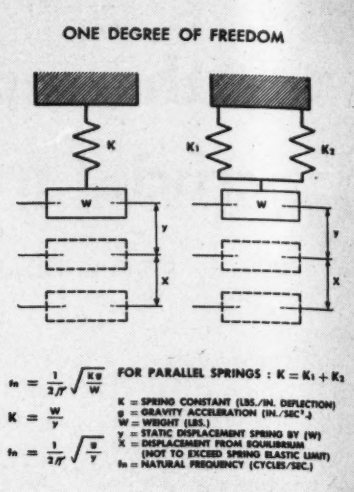
Weld + Ends that will be used to hold the test section of pipe in the center of the main 300-ft length. One pair of 30-in. couplers will be used for the large diameter tests and a pair of 20-in. couplers will be used, in addition, for testing smaller diameter pipe.

The 300-hp, skid-mounted compressor that will be used to pressurize the pipe for the test. Gas will be taken from Texas Eastern's main 30-in. line located nearby.



Correcting and preventing compressor piping vibrations

By N. H. MOERKE and C. NEWMAN
Fluor Corp. Ltd., Los Angeles


ONE DEGREE OF FREEDOM
K
K1
K2
W
y
x
FOR PARALLEL SPRINGS : K = K1 + K2
K = SPRING CONSTANT (LBS./IN. DEFLECTION)
g = GRAVITY ACCELERATION (IN./SEC²)
W = WEIGHT (LBS.)
y = STATIC DISPLACEMENT SPRING BY (W)
x = DISPLACEMENT FROM EQUILIBRIUM (NOT TO EXCEED SPRING ELASTIC LIMIT)
fn = NATURAL FREQUENCY (CYCLES/SEC.)

VIBRATION of a body, such as a piping system, is caused by an unbalanced external force that displaces the mass from a position of rest or equilibrium. A restoring force is set up due to the elasticity of the system which tends to return the body to equilibrium. However, due to inertia, it will pass the original position and create a restoring force in the opposite direction. This cycle will continue until the exciting force is removed, and the oscillations are damped out by external and internal friction.

Natural Frequency. The frequency with which these oscillations take place is a function of the elasticity of the body and the mass that is vibrated. If we consider a simple system with one degree of freedom, the natural frequency can be represented as[8]:

$$fn = \frac{1}{2\pi}\sqrt{\frac{\text{Spring constant}}{\text{Mass vibrated}}} \qquad (1)$$

The physical significance of equation (1) is shown in *Fig. 1* by combinations of weights of springs. The system with two parallel springs can be considered analagous to a supported piping span. The springs are comparable to the elasticity of the pipe, while the vibrating mass is represented by the distributed weight of the piping.

The natural frequency of a supported pipe span without damping can be approximated by substituting the appropriate value of static deflection in the following equation, as shown by Arnold[1]:

$$fn = \frac{1}{2\pi}\sqrt{\frac{g}{y}} \qquad (2)$$

where,
fn = natural frequency (cycles/sec.)
g = gravitational acceleration (in./sec.^{2})
y = static deflection of the pipe (in.)

Static Deflection. The static deflection (y) of a single span of carbon steel pipe with unrestrained ends may be determined by the following relationship[20]:

$$y = \frac{0.0000153L^4\ Wp}{(D^4 - d^4)} \qquad (3)$$

where,
y = maximum static deflection (in.)
Wp = unit weight of the pipe (lb/ft)
d = ID of the pipe (in.)
D = OD of the pipe (in.)
L = length of span (ft)

Effects of End Restraint. The values of deflection by equation (3) will be reduced when there are several spans in series, or the ends are restrained by clamps or anchors. This will increase the natural frequency of the span above the values for unrestrained conditions. Therefore, each length of pipe between spans must be considered individually, depending upon the support and restraint characteristics of the piping system.

Effects of Damping. The natural frequencies that are determined by equation (2) are based upon no damping in the system. In practice some frictional resistance to motion is always present. This reduces the natural frequency below the value for undamped conditions[8]. However, theoretical considerations, together with test data that will be shown later, indicate that a length of pipe has very little inherent damping, and the effects are negligible for most practical considerations.*

Resonance. If a system is acted upon by an unbalanced periodic or harmonic force[7] that has the same frequency or a simple multiple or fraction of the natural frequency of the body, a condition of the resonance can occur. The resulting amplitude of vibration may become very large even if the forces are relatively small. This will be discussed further in a later section.

Fig. 1. Free vibration of spring and weight without damping[1, 8].

Causes of vibration in piping

The major causes of vibration in compressor plant piping are:

1. The unbalanced forces that are set up by the reciprocating and rotating masses of the engine and compressor.
2. The gas stream pulsations that are induced by the compressor pistons and valve action.

Mechanical Forces. In reciprocating engine-compressor units that are commonly used in the natural gas industry, some vibration will exist due to inherent unbalanced forces in the engine. The forces that are totally unbalanced or only partly balanced are primarily due to higher order harmonics of rotating and reciprocating masses of the unit. The most serious harmonics depend upon the type, number of the cylinders, arrangement of cylinders, and crank angles[10].

Torsional vibrations are excited by nonuniformities in the driving torque due to the cylinder gas pressure variations during the firing cycle. Of special significance in engine vibration are the major and minor critical speeds of the various orders that are a function of the

*For more exact methods of predicting natural frequencies, refer to Olson[15], Freberg and Kemler[8] or Timoshenko[19].

This article is adapted from a paper presented at the annual meeting of the California Natural Gasoline Assn. in Los Angeles, Oct. 8-9.

firing impulses in the engine[7].

These forces can result in vibrations that are transmitted to the compressor house floor, walls, structural members of the building, etc. Therefore, it directly follows that the vibrational forces may be transmitted to the piping. In many other fields the problem of vibration transmission from the rotating machinery to the piping is minimized or eliminated by the use of suitable flexible couplings or bellows. In the natural gas compression service, this is seldom possible because of the mechanical design and pressure levels at which the compressors operate. Therefore, it is common practice to couple the piping directly to the flanges on the compressor cylinders which provides a system through which undesirable vibrations are readily transmitted.

However, as a general solution, the relative crank angle between the compressor cylinders that have a common manifold bottle must be taken into account. Based upon the engine crank angle and the location of the compressor cylinders, Murphy[13, 14] shows that in cases where the impulses are uniformly spaced, their sum equals the number of cylinder ends and indicates the important harmonic. However, irregular firing orders should be studied by vector diagrams similar to the methods used in torsional vibration studies[7, 13].

Gas pulsations have been analyzed by many investigators,[2, 3, 4, 6, 12, 13, 15] and field measurements prove that this characteristic of reciprocating compressors results in a source of unbalanced force that can excite vibration-sensitive piping configurations. These gas pressure waves can be transmitted through the piping system to excite vibration in piping or connected equipment at locations that are quite remote from the engine and compressor units. However, it is possible to minimize vibration at the source by isolating the compressor from the piping with carefully designed pulsation dampeners[2, 6, 15].

In addition to the above method of transferring pulsation energy at pipe bends, Baird and Bechtold[4] described a mechanism by which long stretches of unsupported pipe may be excited into oscillation. In this case the sag of the spans due to gravity tends to flatten the pipe, and the forces of the pulse pressure surges tend to straighten the pipe. If the natural frequency of the span is near the pulse frequency, a vibrational displacement takes place.

The adverse effects of vibration on piping

The most important effects of piping vibrations are:

1. Psychological effects.
2. Line breakage.

Psychological Effects. Vibration that is accompanied by noise often results in excessive fatigue in personnel working in the vicinity[17]. In addition, piping vibration usually creates concern for one's safety when a large diameter pipe that may contain gas at 200 to 4500 psig begins to oscillate violently. Therefore, the presence of excessive vibrations may promote an unfavorable reaction by owners and operators toward an otherwise well-designed plant.

Metal Fatigue. The most serious problem associated with piping vibrations is line breakage due to fatigue, since most metals have definite endurance limits[1, 5]. Markl[10, 11] has conducted fatigue investigations on full-scale piping components to evaluate the safety of piping systems when subjected to cyclically varying bending moments due to vibrations, pressure pulsations, or thermal expansion and contractions.

Fig. 2 presents the results of some of Markl's interpretations in the form of a modified Goodman diagram. This compares the results of his work with the stress limitations that are set forth in the

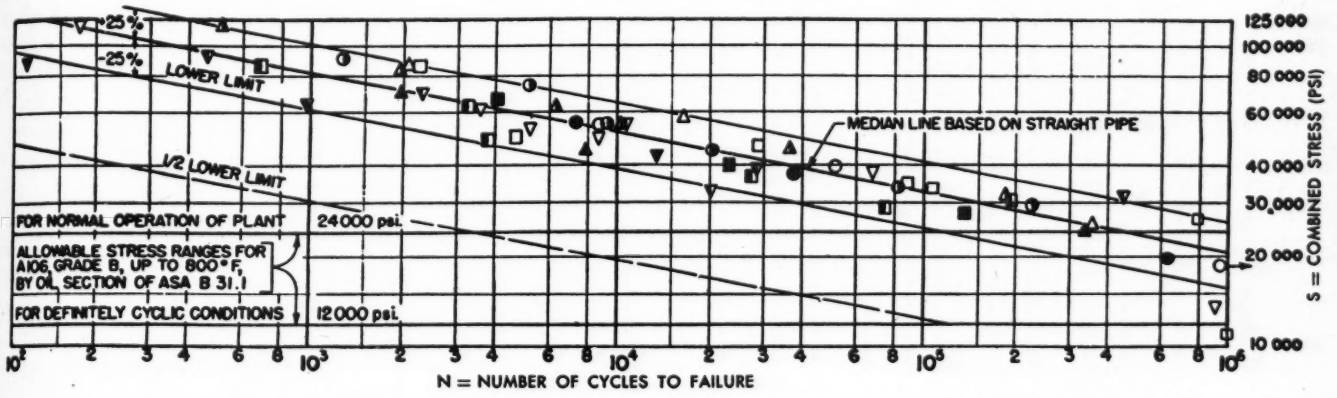


Fig. 2. Correlation of endurance strength with ASA code for pressure piping[12].

Source and Frequency of Pulsations. Pulse pressure waves are set up in the gas stream by the reciprocating action of the pistons and the valve action. This results in rapid periodic fluctuations in the flow rate with corresponding periodic changes in pressure of the compressed fluid[3, 6, 13, 16]. These alternating waves of compressions and rarefactions are known as pulse pressures and travel through the piping system at the velocity of sound in the gas.

In cases where the crank angles between compressor cylinders are equal and all of the cylinders are either single or double acting, the fundamental frequency or number of pressure surges per second can be computed for a reciprocating compressor as follows[4]:

$$fp = \frac{SNA}{60} \qquad (4)$$

where,

fp = pulse frequency in cps
S = compressor speed in rpm
N = number of compressor cylinders using a common manifold bottle
A = the action of the compressor: 1 for single and 2 for double-acting

Effect of Pulsations on Piping. The most important mechanism by which pulse energy may be converted into vibrational energy in the pipe carrying the flowing gas is through changes in the velocity head. This is due to the fluctuating flow conditions as described by Baird and Bechtold[4]. The phenomenon was described by analyzing a change in direction of the gas at a pipe elbow. The fluctuation in the velocity head produces forces proportional to $\left(\frac{V^2}{2g}\right)$ at the bend or elbow. This sets up a pulsating force that will excite the pipe into vibration when the pulse contains frequency components that are near the natural frequency of the piping.

ASA B 31.1 Code for Pressure Piping, using combined stresses composed of torsional, longitudinal (bending and pressure), and circumferential (pressure) stresses as the ordinate, with cycles to failure as the abscissa.

The oil piping within refinery limits, the maximum allowable stress range for ASTM Specification A106 Grade B carbon steel is 24,000 psi for only mild cyclic conditions, and one-half that value for vibratory conditions. These values appear on *Fig. 2* as horizontal lines. The upper one intersects the lower limit of the test data at a point representing about 100,000 cycles, while the lower line is near the endurance limit (normally the endurance strength obtained for at least 2 million and preferably 10 million cycles).

Considering the many indeterminate factors in piping design, Markl states that a safety factor of at least 2 should be used. On this basis the "normal" allowable stress range specified by the code should not be applied where more than 3000 cycles of major stress change are anticipated, perhaps three cycles per week for a 20-year life. This shows the hazardous conditions that can develop in piping when unpredicted vibrational stresses are superimposed upon the normal cyclic and static stresses.

Stress Intensification. In addition to decreasing the predicted "safety factor" when a piping system operates under dynamic stress conditions, there are stress intensification factors that limit the operating safety of the plant, but they are difficult to predict during design phases[1]:

1. Stress concentration.
2. Notch sensitivity.

The stress concentration points are caused by discontinuities in the members, which may be found at welds, flanges, elbows and due to the geometry of the piping. Therefore, it is necessary to keep fillet radii as large as practical and properly reinforce stress concentration points, such as nozzles, etc.

Notch sensitivity is a characteristic of most metals that can result in localized stresses in excess of the predicted values. These stress concentration points may be caused by such irregularities as surface nicks, arc marks, laps in the pipe wall, etc. It is important to carefully inspect piping that will be operated under dynamic stress conditions in order to prevent failure from this source.

Conventional practice in compressor plant piping design

The major steps in compressor plant piping design are the determination of:

1. Pipe and vessel sizes.
2. Wall thicknesses.
3. Pipe support and hanger locations.

Pipe Diameters. The diameters of the suction and discharge laterals and headers are determined on the basis of allowable pressure drop, which, of course, is based upon economic considerations. In some cases it has been found desirable to use line sizes somewhat larger than normally would be required for smooth flow, since the presence of pulsations in piping tends to increase pipe friction[6].

Manifold Sizes. The diameters of the suction and discharge manifold bottles are normally fixed by volume recommendations that are made by the compressor manufacturers. In many cases the volumes are determined by using a multiple of the compressor cylinder displacement to determine the minimum volume requirements.

Pipe and Vessel Wall Thickness. The wall thickness of the piping and bottles are calculated on the basis of the allowable stresses that are specified in the codes, such as ASA, API-ASME, or ASME.

Pipe Supports and Hangers. Pipe support and hanger locations are usually determined by considering the pipe runs as continuous spans, and placing the supports at intervals that will keep the bending and thermal stresses in the pipe within the limits that are specified by the codes. In addition, it is necessary to maintain the deflection in the span at a minimum to prevent the collection and pocketing of liquid at these points. Simplified charts have been prepared that take both stresses and deflection into account[9, 18].

Solutions to the pipe vibration problem

It is obvious that every effort should be made to minimize the cause of vibrations at the source. Therefore, the plant must include adequate foundations under the engines and compressor to absorb the major vibrations. In addition, provisions should be made to decrease gas pulsations as close to the source as possible, as discussed by Stephens[16], Arnold[2], Chilton and Handley[6], and others. When these exciting forces have been minimized to the satisfaction of the designer, consideration should then be given to the vibration susceptibility of the piping system.

Engine Foundations. The foundation for a reciprocating engine compressor unit must perform three functions:

1. Support the weight of the unit.
2. Maintain proper alignment.
3. Absorb vibrations.

The absorption of vibrational forces is probably the most important of the above requirements; therefore, the foundations must have sufficient mass or weight to absorb vibrations. Theoretically, the minimum weight required could be expressed as a function of the weight of reciprocating masses and engine speed. Practically, this is seldom done, and empirical formulas are normally used[10].

Solutions to minimize pulsations

The best solution to the problem of piping vibrations due to pulsations is the isolation of the piping from the pressure surges that are produced by the compressor. A number of papers have been published on this subject by Arnold[2], Stephens[16], Chilton and Handley[6], Baird and Bechtold[3], and others to provide a comprehensive treatment of the solutions to pulsative flow problems.

The usual methods of minimizing pul-

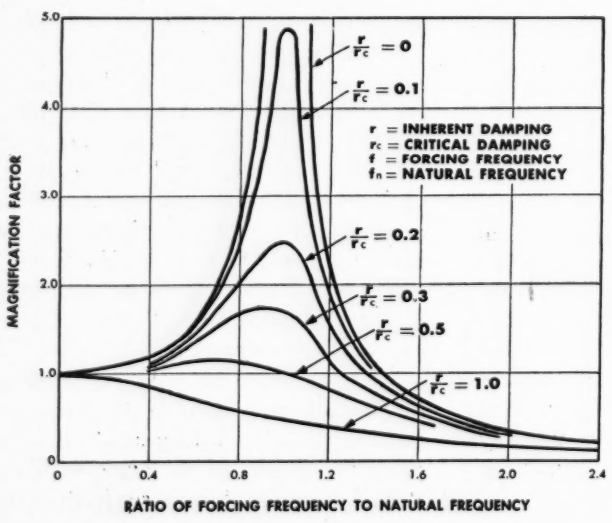


Fig. 3. Magnification factor as a function of damping and frequency ratio[8].

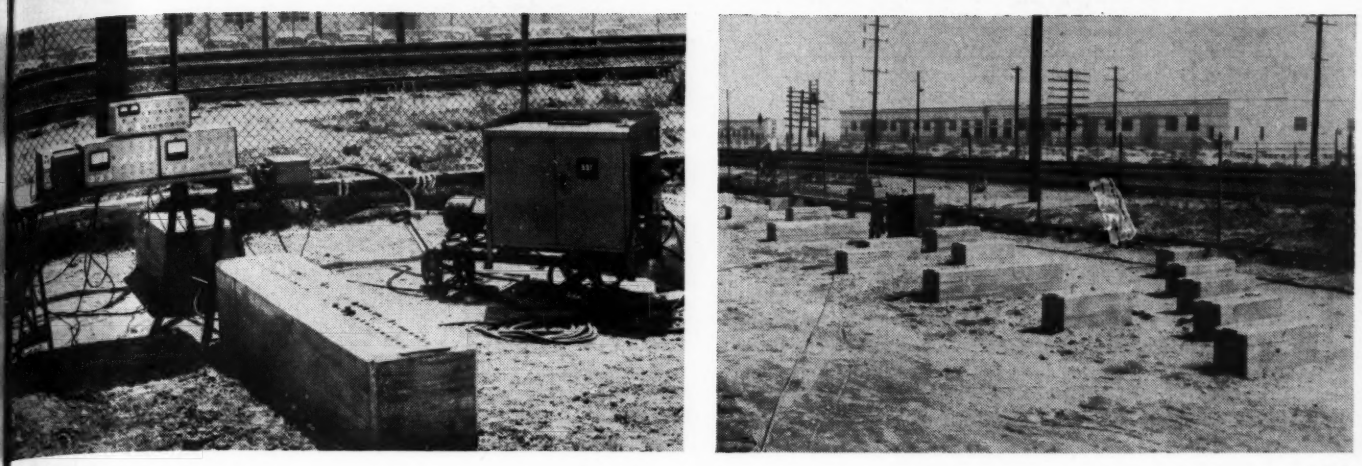


Fig. 4. Pipe vibration test facilities.

sation in the gas streams are as follows:

1. Pulsation dampeners.
2. Pulsation dampening piping systems.
3. Adequately sized volume bottles.
4. Increasing diameters of compressor plant piping.

Pulsation Dampeners. The most efficient method of decreasing gas pulsations in the piping is to use pulsation dampeners or π-type low-pass filters as discussed by Chilton and Handley[6]. Equally efficient are the pulsation dampening systems that incorporate the elements of the pulsation dampeners in the design of a complete compressor piping system. This is accomplished by utilizing the manifold bottles, laterals, and headers as the components of a low-pass filter[2]. Properly designed pulsation dampening equipment can decrease the magnitude of pulse pressure from the cylinders by 85% or more.

Manifold Bottles. The installation of adequately sized manifold or volume bottles is another conventional practice in gas compression piping design to decrease pressure pulsations. However, it has been reported by Chilton and Handley[6] that the pulsations going into the piping will be twice as large with a carefully designed volume bottle as with a comparable pulsation dampener or π-type low-pass filter.

The size of the volume bottle must be given careful consideration to prevent magnifying pulsations. Murphy[13,14] states that the misguided addition of a surge chamber may merely lower the natural frequency of the piping system so that the frequency can coincide with the important harmonic of the compressor speed. Then the total pulsation of the gas can be increased from forced oscillation to a more severe resonant vibration. Therefore, the practice of designing surge chambers (manifold bottles) by using a multiple of the displacement of the cylinders seems hazardous.

Line Sizes. Another method of minimizing the effects of pressure pulsations in the gas stream is by increasing piping diameters in excess of the sizes that would be required for "smooth flow." This practice compensates for the increase in pressure drop that is inherent with pulsative flow[6], and increases the stiffness of the piping to decrease the vibrations that are induced by pulsative flow conditions.

Differentiation between sources of vibration

It is usually difficult to distinguish between piping vibrations that are caused by gas stream pulsations and mechanically excited vibrations without extensive electronic measurements interpreted by skilled engineers. Extensive work in this field has led to the development of the Fluor mobile laboratory. However, from field experience it has been found that a fairly accurate indication of the source of vibration, whether mechanical or pulsative, can be made in cases where the block valves in the laterals are near the compressors.

It has been found that "pinching" the block valves to take a pressure drop across the valves of about 10% of the operating pressure will decrease vibrational displacement of the piping that is downstream of the valve on the discharge side or upstream on the suction side when the major exciting force is because of gas pulsations. However, if there is not a noticeable decrease in vibration, it may be assumed that the major exciting force is mechanical.

The valve pinching operation must be performed on all units that are feeding into a common header system, because pulsation feedback and mechanical coupling with the other units may give erroneous indications.

Characteristics of vibration in piping

The variables that determine vibrational characteristics of a pipe span or configuration are:

1. Diameter of the pipe.
2. Wall thickness of the pipe.
3. Length of the pipe span.
4. Restraint of the piping by anchors, hangers, or guides.
5. Thermal and bending stresses in the pipe.
6. Elasticity of the supports.

Most of the above factors in piping design are set by economic, mechanical, process, and structural design considerations. Therefore, it is logical for the designer to select variations in pipe support spacing and piping configurations in order to adjust the vibrational characteristics of piping. This will have the least conflict with the overall design of piping system.

The Types of Vibration. The types of vribation in a length of pipe may be longitudinal, torsional, radial, or transverse. However, for the purpose of this discussion we will confine our analysis to transverse oscillation. This is normally the direction in which a span of pipe has the least stiffness and, therefore, the greatest susceptibility to vibration. It is interesting to note at this point that longitudinal forces can cause transverse vibration in system when there is a nonsymmetrical disposition of mass or coefficient of stiffness about the longitudinal axis[17]. This condition will occur in a span of pipe where the sag results in nonsymmetrical distribution of mass with respect to the pipe's longitudinal axis.

Synchronous Vibration in Piping. Each

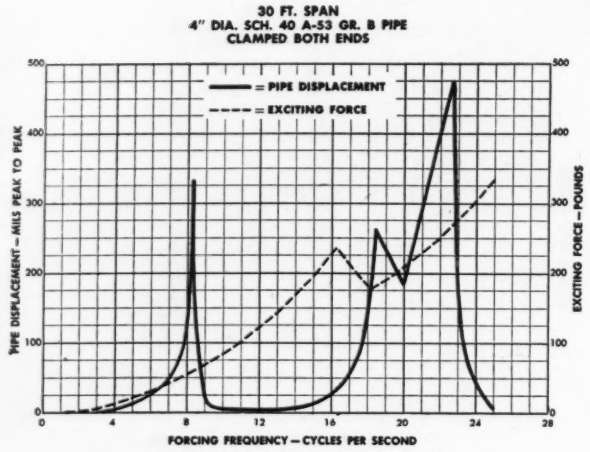

30 FT. SPAN
4" DIA. SCH. 40 A-53 GR. B PIPE
CLAMPED BOTH ENDS
= PIPE DISPLACEMENT
= EXCITING FORCE
PIPE DISPLACEMENT – MILS PEAK TO PEAK
EXCITING FORCE – POUNDS
FORCING FREQUENCY – CYCLES PER SECOND

Fig. 5. Frequency response of pipe span.

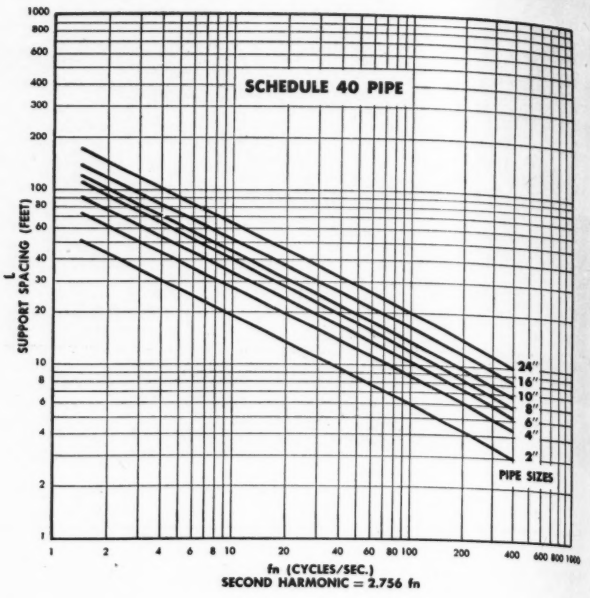


Fig. 6. Natural frequencies of pipe spans clamped both ends (calculated) [15].

span of piping has a fundamental frequency of vibration. This frequency is a function of the length of the span, diameter of the pipe, wall thickness, restraint by anchors and guides, and the elasticity of the supports and pipe anchors or guides.

If a span is set into oscillation by forces that are recurring at regular intervals, and these intervals are the same as the natural time period or a simple fraction of this time period, the amplitude of vibration of the body may increase even though the force applied is not large. Such conditions are called resonance, and they may become structurally dangerous for the operation of the piping system.

In actual installations, inherent damping in the piping system tends to limit the vibrational displacement that is reached in practice at resonance. This phenomenon of forced vibration with damping is described by Arnold[1]. The characteristics of a vibrating system with damping are shown in *Fig. 3*.

In *Fig. 3* the magnification factor is a parameter that is multiplied by the equivalent "static deflection" of a body to obtain the dynamic amplitude. This factor has been plotted to show the effects of various frequency ratios on the amplitude for several ratios of damping, with $\left(\frac{r}{r_c}\right)$ representing the ratio of damping to critical damping. The value "r" is the resistance in the body that tends to decrease vibrational displacement. The factor "r_c" (critical damping) is the value of damping at which no vibratory motion can exist, and the displacement becomes zero very quickly.

Three distinct regions should be noted. At very low ratios of forcing frequency to the natural frequency, the motion is very nearly equal to the static deflection that would be caused by a force equal to the disturbing force[1, 8]. As the frequency ratio $\left(\frac{f}{fn}\right)$ increases, the amplitude of displacement becomes larger until the ratio reaches 1.0. The displacement increases as the damping decreases, and with no damping it will approach infinity when the forcing frequency is equal to the natural frequency. However, all actual systems have some damping where there is motion[8]. This limits the displacement as shown in *Fig. 3*.

Measured Natural Frequencies. In order to analyze the characteristics of piping spans under simulated field conditions, Fluor has set up a full scale testing facility. Concrete supports are oriented so that various combinations of pipe spans can be analyzed. A photograph of the test area is shown in *Fig. 4*. On this installation it is possible to duplicate actual pipe configurations and vary the length of spans and pipe wall and vibrational accelerations and displacements.

The various spans of piping are excited with a Lazan oscillator which allows the frequency and unbalanced forces on the system to be varied over a wide range. In *Fig. 5* the results of a determination of displacement as a function of exciting frequency and force are shown for a span of piping that is 30 ft long. This pipe is 4-in. diameter, Schedule 40 A53 Gr. B. The curve indicates that the piping system has low damping; therefore, it has a high displacement at the resonant condition, where the forcing frequency is equal to its natural frequency.

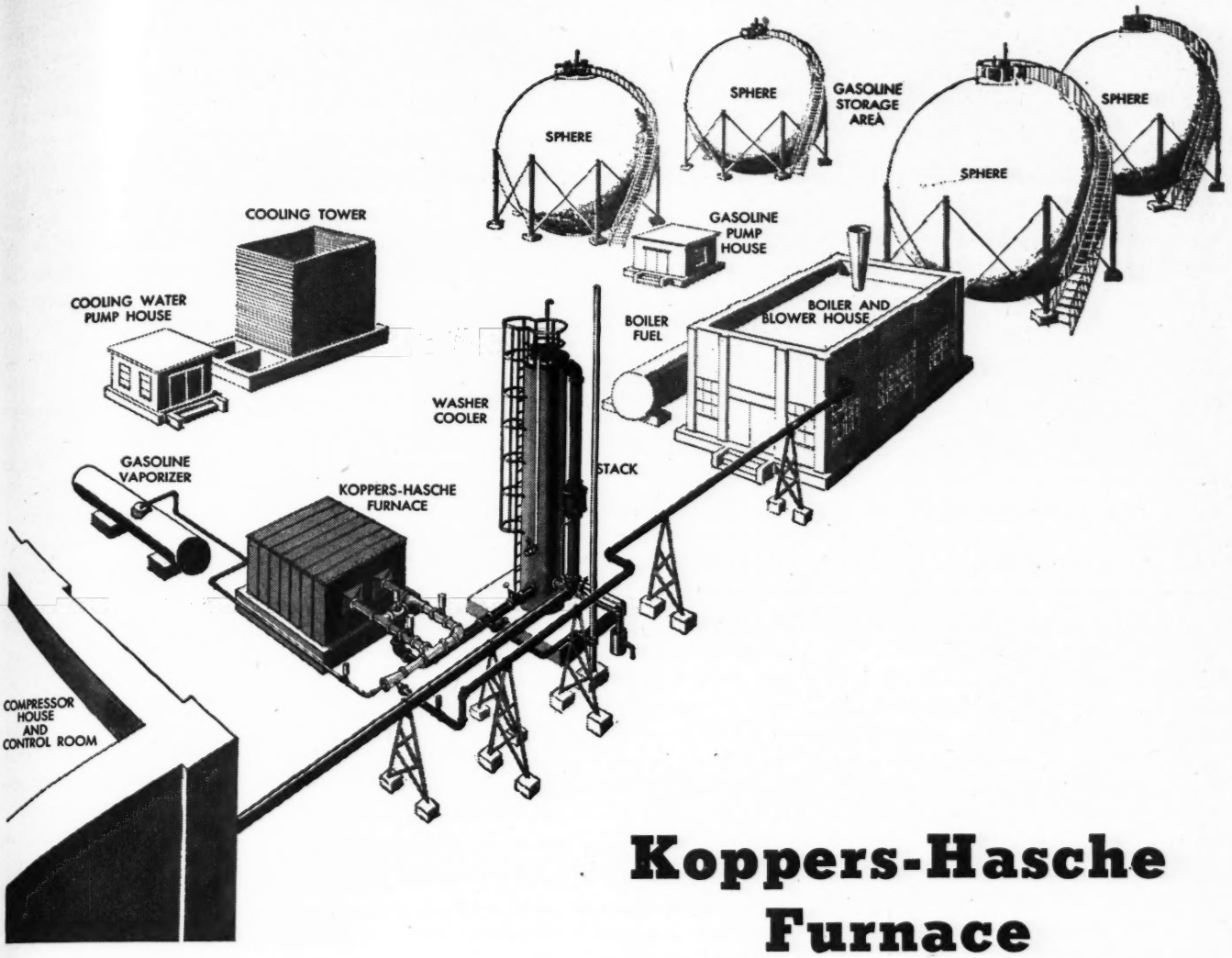
The section of pipe under test was part of a system composed of five similar spans clamped to concrete supports. The theoretical first harmonic of the natural frequency was 8.4 cycles per second. The measured fundamental natural frequency was 8.26 cycles per second. It is recognized that the elasticity of the supports lowers the natural frequency by increasing the effective length of the pipe span[8]. However, no attempt has been made at this time to isolate these variables.

Calculated Natural Frequencies of Pipe Spans. The calculated values of natural frequency for a pipe span that is clamped to the concrete supports at each end are shown in *Fig. 6* for Schedule 40 pipe. These calculations were based upon tabulations of general equations that are presented by Olson[15] and Freberg and Kemler[8]. A similar study has been made for various combinations of supports, such as simply supported spans, spans clamped at one end and supported at the other, cantilever, etc.

Pipe spans based upon the natural frequency and engine or compressor harmonics

It was suggested by Arnold[1] that pipe supports should be spaced so that no part of the piping system has a natural frequency of vibration equal or nearly equal to the frequency of any periodic force created by the engine or compressor. As was shown in *Fig. 3*, if the ratio of forcing frequency to the natural frequency of a system is greater than about 1.4, magnification factors of less than 1.0 can be obtained to give the ideal solution to vibration.

However, as Arnold[1] points out, severe piping vibrations will occur for design frequency ratios of about 1.4 when the unit is shut down. The frequency of the forces will be in resonance with the pip-



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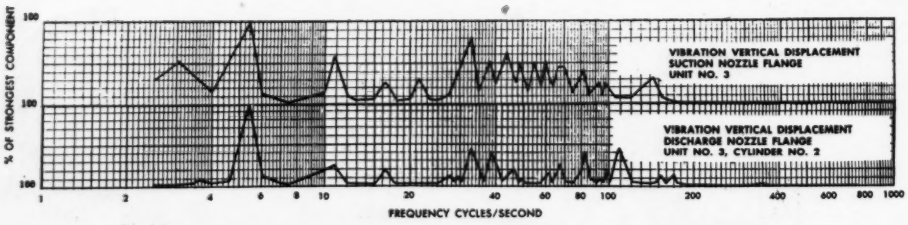


Fig. 7. Vibration displacement frequency analysis. (Twelve-hp gas engine, 2-cycle, 6-cylinder operating at 320 rpm, crank angle 60°.)

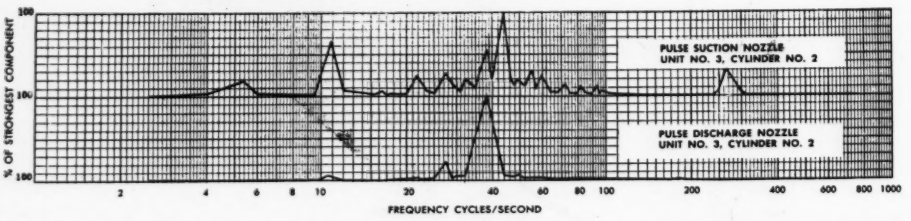

% OF STRONGEST COMPONENT
PULSE SUCTION NOZZLE
UNIT NO. 3, CYLINDER NO. 2
PULSE DISCHARGE NOZZLE
UNIT NO. 3, CYLINDER NO. 2
FREQUENCY CYCLES/SECOND

Fig. 8. Pulse amplitude freqency analysis. (Three-cylinder, double-acting compressor, 7¼-in. bore, 16-in. stroke. Service: natural gas; suction: 650 psig at 47°F; discharge: 1200 psig at 142°F; flow rate: 33.3 MMscf/day; speed: 320 rpm; crank angle: 120°.)

ing, and destructive vibration could result as the engine speed decreases to a value that results in a frequency ratio of 1.0. Therefore, it is probably safer to design for frequency ratios between 0.25 and 0.50 although the magnification factors may be slightly greater than unity. Maleev[10] described a similar procedure for engine design to avoid critical speeds during operation. In this case the natural frequency of vibration should be above the lowest engine harmonic at the maximum engine speed.

The difficulty in applying the design method suggested by Arnold[1] arises in the selection of the design frequency to use in selecting pipe spans, etc., so that the natural frequencies will be above the range of exciting frequencies of the engine and the compressor. However, empirical relationships, based upon field measurements on a number of engine and compressor units, coupled with theoretical analysis, will enable the designer to predict the most serious frequency within engineering accuracy.

Engine Speed First Harmonic or Fundamental Frequency. The first harmonic frequency of the inertia forces of the reciprocating masses is considered to be concentrated at the crankpin. This frequency is equal to the crankshaft speed or the frequency in cycles per second is $\frac{rpm}{60}$.

Engine Speed Harmonics. In addition to the first harmonic, higher harmonic frequencies are found in the vibrational forces. These components are dependent upon the engine type, number of cylinders, etc., such that these forces may be inherently unbalanced at the higher harmonics as described by Maleev[10]. Additional higher harmonics are also injected into the system by the effects of variations in power cylinder gas pressure upon the torque that may excite vibrations. These components differ between four-cycle and two-cycle engines. The major and minor harmonics may be determined by vector diagrams as shown by Den Hartog[7]:

1. Four-cycle internal combustion engines have harmonic components of the half-order, i.e., ½, 1, 1½, 2, 2½, 3, 3½, 4, 4½, 5½, 6, etc.
2. Two-cycle engines have only harmonics of the integer order, i.e., 1, 2, 3, 4, 5, 6, etc.

The most serious harmonic is indicated where all of the torque vectors have the same phase. The higher harmonics usually have smaller amplitude and are less serious. *Fig.* 7 shows the results of a field vibrational frequency analysis on the suction and discharge flanges of a six-cylinder two-cycle engine.

Fundamental Pulse Frequency. The fundamental pulse frequency was presented in the preceding section; however, higher harmonics of this frequency depending upon the wave shape usually exist as discussed by Baird and Bechtold[3].

Pulse Harmonics. Higher harmonics of the pulse frequency are usually found in the gas pulsations. This has been discussed by Murphy[13], Baird and Bechtold[3, 4], and Chilton and Handley[6]. These harmonics are a function of the wave shape of the pulse which is affected by such factors as erratic valve action, pocket characteristics, and size and configuration of associated piping. *Fig.* 8 shows the results of a pulse frequency analysis in the suction and discharge nozzles of a compressor unit with three double-acting cylinders located at 120° crank angles. Murphy[13, 14] has presented an excellent analysis of the harmonic components that may be found in the gas stream by adding the appropriate harmonics by vector diagrams. This indicates the number of the harmonic where the vectors are parallel and in the same direction.

In pulsation dampener design we are interested in the lowest frequency present in the system, since a low-pass filter attenuates harmonic components above a cut-off frequency, and lower frequencies pass through the pulsation dampeners. However, in the design of compressor piping systems the natural frequency of the piping should be above the highest forcing frequency in the system.

Selection of piping spans to minimize vibration

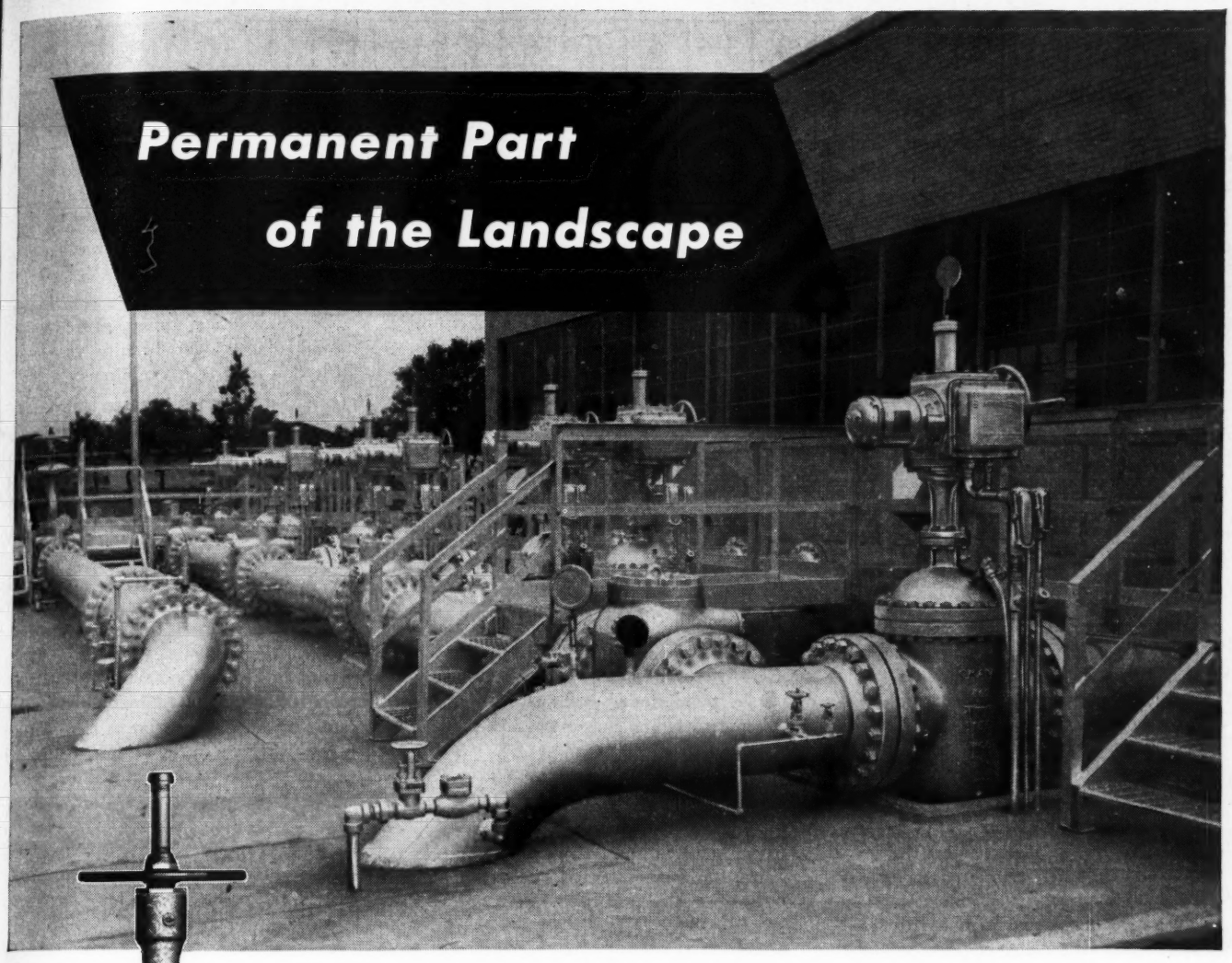
Forcing Frequencies. In the design of the pipe span lengths it would be desirable to have a measured frequency analysis of the mechanical and pulsation frequencies in the piping; however, this is seldom practical in engineering work. Therefore, an estimate of the design frequency can be based upon the engine harmonics and pressure pulse frequency harmonics. These harmonics may be determined by constructing a vector diagram of the engine forces with the proper crank angle relationship as shown by Den Hartog[7]. A similar diagram can be made to determine the most serious pulsation frequency as discussed by Murphy[13, 14].

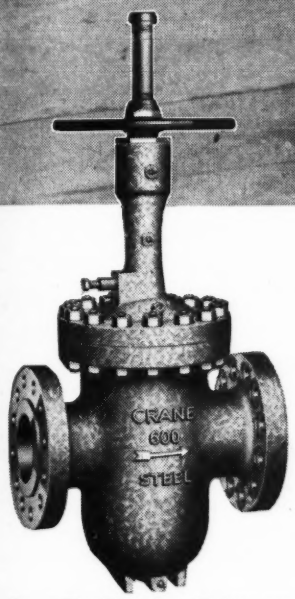
Based upon a large number of field measurements, a rough approximation of the upper limits of the highest harmonics can be made as follows:

1. Highest engine frequency—four times the firing frequency of the engine.
2. Highest pulse frequency—four times the "puff" frequency from the compressor cylinders.

The above relationships must be used only as guides for estimating support requirements. For final design apply the vector diagram method of analysis that was discussed previously.

Piping Spans to Minimize Vibration. For the purpose of locating pipe supports to minimize the effects of vibrations because of mechanical excitation or pulsations in compressor plant piping, we suggest the following procedure that will result in a piping system wherein the critical speed characteristics of the pip-





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MAXIMUM SPAN FEET	7	9	10	11	12	13	14	16	17	19	22	23	25	27	28	30	32

Fig. 9. Maximum spacing between pipe supports (based upon bending stresses and deflection)[9]. (Used for schedule 40 pipe.)

ing are above the most serious harmonics of the forcing frequency.

1. Measure or estimate the highest mechanical and pulse frequencies in the system as discussed above. Use the highest of the two for determining support locations.

2. For pipe support spans with *clamps* at each end of the span, enter *Fig. 6* on the abscissa at the design natural frequency of the pipe span (fn) so that $\frac{f}{fn} = 0.5$ or $fn = 2f$

where,

fn = natural frequency of pipe span

f = maximum exciting frequency.

Read up to the pipe diameter under consideration, and the recommended length of the pipe span will be found on the ordinate in feet of span.

3. Compare the above value to the *maximum* allowable pipe spans that are shown in *Fig. 9*. These values will maintain stresses in the pipe wall below normal code values, and the deflection will be negligible[9].

4. In the final location of the support spacing, experience indicates that the spacing should be varied with a range of about 10% below the calculated maximum span so that adjacent spans will not have identical spacings for the diameter of pipe under consideration. If the calculated maximum span is 12 ft, the adjacent span should be about 11 ft in order to decrease synchonous vibrations.

5. Calculate the thermal expansion of the pipe. This will indicate the type of hold-down clamp or anchors, and the locations in order to minimize thermal stresses in the piping. It is desirable to keep these stresses low, because they act as compression on a restrained span to lower natural frequency.

It has been recognized that compressor and engine piping vibrations have adverse and sometimes dangerous effects in the system; therefore, the follow recommendations will provide conservative designs and aid in decreasing the magnitude of vibratory conditions.

1. Minimize the source of mechanical vibrations by proper balance of the compressor unit, and provide adequate foundation to absorb the residual vibrations in accordance with the soil bearing conditions and the engine maker's recommendations.

2. Decrease the vibrations that are caused by pulsative flow conditions by attenuating the gas pulsations as close to the compressor as possible. Preferably use pulsation dampeners.

3. Place pipe supports and hold-downs at intervals that will maintain the natural frequency of vibration of the pipe spans above the highest major engine or gas pulsation harmonics.

4. Provide adequate footing for the concrete pipe supports to prevent "rocking." This will decrease coupling of vibrations from one run of pipe to parallel spans, when a common support is used for several lines. In addition, keep the projection of the support above grade as short as possible for maximum stiffness of the support.

5. Use sturdy hold-down clamps, guides, and anchors that have a high degree of stiffness and high natural frequency. Place supports, guides, hold-downs, or anchors at all changes in direction of the piping within limits of required pipe flexibility and thermal expansion.

6. Provide footing for the steel beam and overhead pipe supports that is adequate to minimize rocking. The stiffness of all structural members should be as great as possible.

7. Exercise extreme care to be certain that the pipe is resting firmly on the pipe support and not pulled down to the support by the clamps, hold-downs, or anchors. In all cases use shims to correct for any errors in elevation of the pipe supports.

8. In cases where a number of various sizes of pipe use the same support, design the span between adjacent supports so that the natural frequency of vibration of the smallest diameter pipe will be above the range of engine and compressor vibration and pulsation harmonics. If this is not possible because of economic or practical limitations, it has been found helpful in some cases to firmly tie the smaller diameter pipe to an adjacent larger pipe. This practice must be used with extreme caution, because it can result in coupling vibration from the smaller pipe to the larger and accentuating the problem; therefore, this approach should be reserved as a field expedient for correction only.

9. Keep thermal stresses in the piping at a minimum by the proper selection of hold-down clamps, expansion loops, etc.

10. Design so that "cold springing" does not exceed the limits that are specified by the ASA Code, generally one-half the theoretical thermal expansion.

11. Place expansion loops and bends horizontal wherever possible. In all cases support the bends at the center of the loop, but do not restrict movement due to thermal expansion. Place guides at several locations adjacent to the bend or loop at locations that will not seriously restrict thermal expansion.

12. Use a minimum of elbows. If it is necessary to connect the laterals and headers at different elevations, use 45° ells instead of 90° ells in cases where piping flexibility is not critical.

13. Support all heavy valves, flanges, and piping configurations, such as bypass piping, to keep static bending stresses and deflection in pipe at a minimum.

14. Support the discharge bottles under each compressor nozzle to prevent movement of this relatively large mass that can transmit vibratory movement to the allied piping. In addition, keep the length of nozzle as short as possible for both mechanical and acoustical reasons.

15. Keep the nozzles on the suction bottle as short as practical for the highest natural frequency in the system. In addition, in the normal case where the suction manifold bottle is located above the cylinders, the unsupported mass of the bottle must be kept within limits that will not cause deflection in the compressor cylinder supports and discharge manifold bottles. If additional volume is required above the limits set by the allowable mass of the bottle, use an oversized riser pipe or a two-bottle pulsation dampener design.

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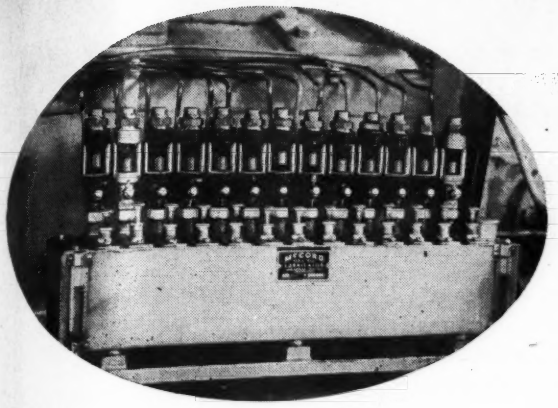


Photo by GAS Magazine

Fig. 1. A force feed lubricator installed on one of the Cooper-Bessemer GMW engines at the Topock compressor station showing the new metallic bobber indicators. The lubricator is a conventional unit with metallic bobbers installed in place of indicating fluid.

Metallic bobber developed for force-feed lubricator

THE reaction of detergents and other additives in heavy duty lubricating oils with indicating fluids used in sight feed indicators on engine and compressor lubrication systems has led to the use of a metallic indicator which, in addition to eliminating the reaction problem, has unexpectedly provided engineers with an indicating device that is both more positive and more readable than the original method of indication by "drop."

The application of metallic type indicators resulted from a particularly aggravating case of additive reaction which developed recently at the Pacific Gas & Electric Co. Topock compressor station, where indicator fluid carried over into the oil lines, causing encrustation to develop when the compressors were idle for a period of time. The Topock case, where it was found that the indicator fluid, generally a combination of glycerine and water, was highly soluble in oil of the additive type, was the first to draw attention to the problem.

W. V. Adler, plant foreman at Topock, and lubrication engineers from the Shell Oil Co. collaborated on the problem and investigated a number of other fluids that might be used in a sight glass indicator. However, nothing of the proper specific gravity to act as an indicator in oil was found that was at the same time insoluble in the additives.

It was at this point that Shell engineers suggested the use of a metallic indicator that had been developed by the McCord Corp. for use with their lubricators. By the substitution of a metallic indicator for the indicating fluid, all chance of reaction was eliminated.

In addition, compressor operators at Topock found the new indicating device far more readable than the drop method. Movement of the bobber could be seen from a considerably greater distance than could the movement of drops in the fluid type sight glass *(Fig. 1)*.

As a result of satisfactory test installations, metallic bobbers have replaced indicating fluid on all compressors.

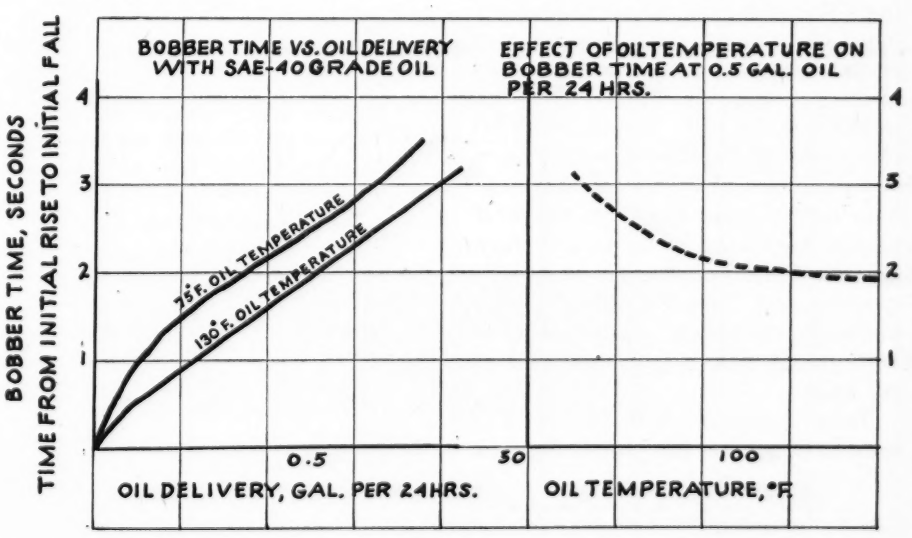
The bobber itself is made of brass with a steel stem which controls the lift. It fits in the ordinary sight glass and lubricator assembly. A close fitting pin works inside the standard nozzle opening where the oil drop is normally formed. Oil movement causes the bobber to rise and fall with each pump plunger stroke. Bobbers made of aluminum are also available for use with light bodied oils.

The new metallic type bobber also gives a positive method of determining the actual amount of oil that is delivered to each of the oiled points. Tests have indicated that oil drops appearing in a sight feed glass may appear to be alike but still vary as much as 50% to 75% in volume. One reason for this is that the specific gravity of the fluid may vary with the mix used in the sight glass. Any variation in the relative proportions of glycerine and water mixed into the fluid will result in a different size drop to appear in the glass.

Also, the nozzle tip will sometimes become corroded and greater capillary action will be exerted on the drop, causing it to become larger than normal. In some oils a larger differential occurs between the specific gravity of the oil and the sight glass fluid, and instead of developing a drop on the nozzle the oil will tend to string up the wire.

The manner in which bobbers will indicate the exact amount of oil delivered to the system is shown in a set of curves worked out by Shell Oil Co. engineers *(Fig. 2)*. A sight glass equipped with a metallic bobber can, with the application of calibration curves, be made to show exact volumes of delivered lubrication oil even when it is reduced to extremely small amounts.

Fig. 2. Calibration chart for McCord force feed lubricator using metallic bobber as an indicating device. Both charts are for a speed equivalent to 250 rpm on Cooper-Bessemer GMW engines.


BOBBER TIME VS. OIL DELIVERY WITH SAE-40 GRADE OIL
EFFECT OF OIL TEMPERATURE ON BOBBER TIME AT 0.5 GAL. OIL PER 24 HRS.
BOBBER TIME, SECONDS TIME FROM INITIAL RISE TO INITIAL FALL
75° F. OIL TEMPERATURE
130° F. OIL TEMPERATURE
0.5
OIL DELIVERY, GAL. PER 24 HRS.
50
100
OIL TEMPERATURE, °F.
1
2
3
4

Progress in large volume measurement

with a report on the Refugio large diameter orifice meter test

• By F. M. PARTRIDGE
Southern California Gas Co.
Los Angeles

A GREAT deal of research and experimental work was conducted by the American Gas Assn. and the American Society of Mechanical Engineers between 1924 and 1935 in developing orifice meter coefficients and standards of construction for orifice meters. In 1935, a joint AGA-ASME report was issued with the title "History of Orifice Meters and the Calibration, Construction, and Operation of Orifice for Metering." This report is the basis for almost all present-day orifice meter measurement. For the benefit of the gas industry, a special report, "Gas Measurement Committee Report No. 2," was published in 1935 by the natural gas department of the AGA.

These reports set forth the results of tests to determine the proper form for

This article is adapted from a paper presented at the AGA convention in St. Louis, Oct. 26-28.

The orifice meter and the six compensating factors

For the measurement of moderate to very large daily volumes of gas between companies and even within a company, the orifice meter outnumbers all other types many times. Among the more important reasons for this are:

1. For handling any given rate of flow, the initial cost is relatively low.
2. It can be altered rather easily to accommodate changed flow requirements.
3. It presents a minimum of obstruction to the flow of gas, and foreign objects (e.g., stones) which may get into a pipeline will cause little damage.

The heart of an orifice meter is merely a flat round plate with a hole in the center which is placed in a pipeline of flowing gas. A small hole or pressure connection is made in the pipe wall on each side of this plate and the drop in pressure as the gas passes through the orifice is an indication of the rate of flow. This appears to be simple enough, and is rather simple, except that no fluid conforms exactly to simple physical relations. Gases are especially nonconforming. The result is that in order to relate actual flows to the simple physical relations it is necessary to determine and apply some additional factors. Some of the factors are based upon the results of experimental determinations, while others represent the character or condition of the gas.

The more important of the factors are:

1. The basic orifice factor. This relates the actual rate of flow (of any fluid) through an orifice to that which would be given a simple physical relation. Our present tables of these factors are based on calibration tests run with pipes ranging from 2 in. to 14 in. and now to 30-in. pipes.

2. The Reynolds number factor. This factor is used to provide a common basis on which the actual conditions of measurement can be related or compared to those under which the basic factors were determined.

3. The expansion factor (for gases only). When a liquid flows through an orifice its density does not change, and all of the pressure drop is applied to accelerating the stream. With a gas, some expansion takes place, and a part of the observed pressure drop is expended in producing this expansion, or change of density, so that only a part of the observed pressure drop goes to accelerating the gas. The expansion factor compensates for this expansion of a gas compared to a liquid.

4. The specific gravity factor. Stripped of details, the specific gravity is the ratio of the weight of a cu ft of gas to that of air. It is well known that the acceleration produced by a given force varies (inversely) with the mass (weight) of the body. Thus this factor compensates for the relative unit weight of the gas being metered. A change of 0.05 in the specific gravity of a gas, which is not unusual, will change this factor by about 4%.

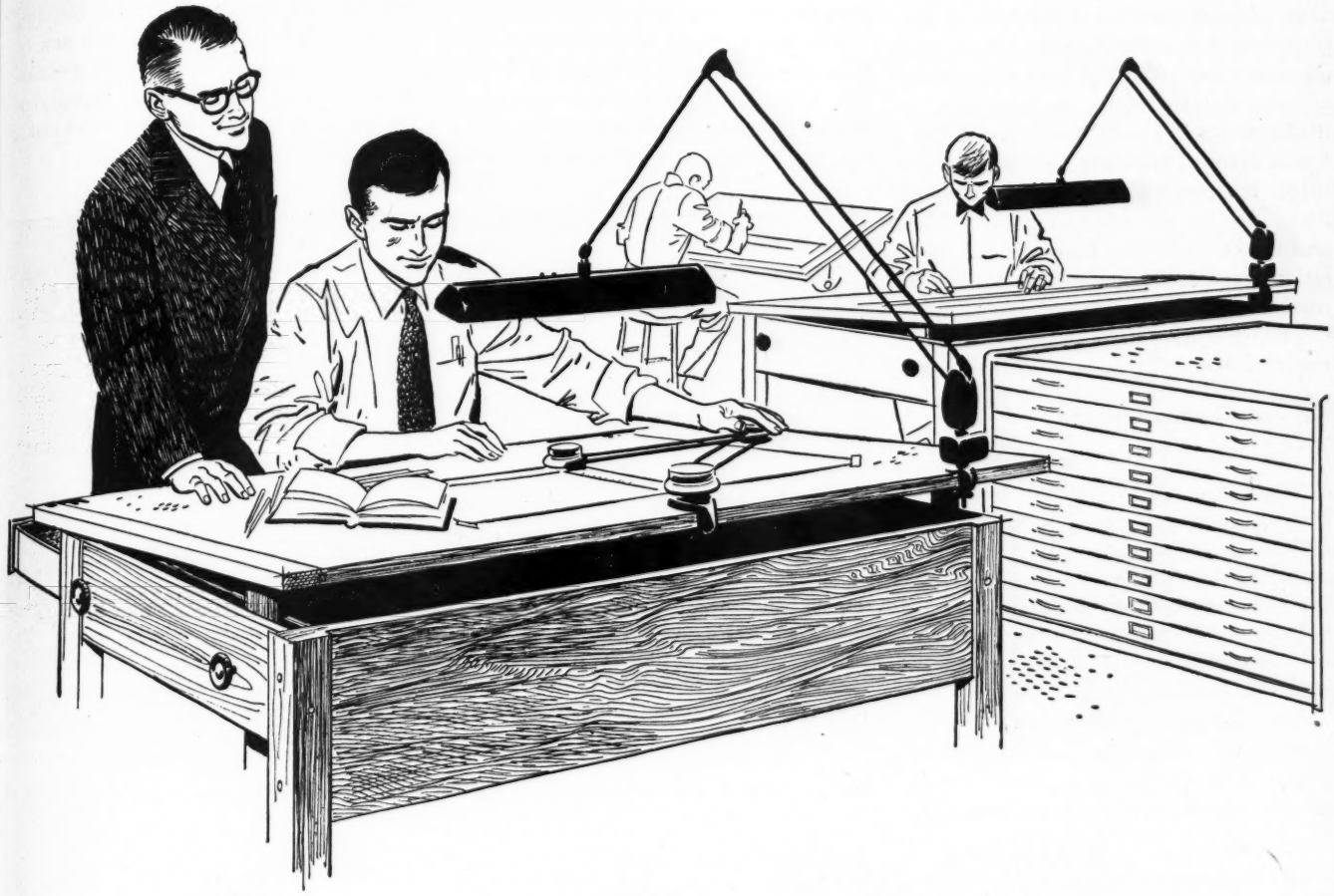
5. The temperature factor. In order to compare two or more volumes of gas, the temperatures should be the same (or the volumes referred to a common temperature). This is the function of this factor. A change of 10° F in the temperature of the gas will change this factor about 1%.

6. Supercompressibility (or superexpansibility) factor. Natural fuel gases deviate noticeably from the simple relation that the volume of a gas is inversely proportional to the absolute pressure. This factor compensates for this deviation.

The first three factors are obtained from experimental tests which covered a wide range of conditions, such as size of pipes and orifices, rates of flow, and kinds of fluids. The last three factors reflect the character or condition of the gas at the place of measurement.

Obviously, if the flow of gas through an orifice were at a constant rate with no change in its temperature, pressure, gravity, or composition, then an appropriate value for each of these factors could be selected once and for all and computation of the flow would become a machine operation. However, all of the conditions upon which these factors depend are variable to a greater or lesser extent and it is necessary to alter the factors frequently to compensate for the variations.

RIGHT AT THE BEGINNING—



Plan on using Bitumastic® Enamel to protect your pipe line against corrosion

ANY pipe line, whether large or small, is an important investment — an investment that should be properly protected.

That's why it's wise, when planning a new pipe line, to include Bitumastic Enamel in your designs, plans and specifications. Bitumastic Enamels, manufactured from selected coal-tars have proved they can prevent corrosion. Many oil and gas pipe lines, that were coated with Bitumastic Enamel and laid 20 and 30 years ago, are still giving good service today.

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the orifice flange, the correct size and location for the pressure tap holes, the numerical value of the expansion factor, Reynold's number factor, and the deviation from Boyle's Law.

The method of application of these data has been largely left to the discretion of the users. Various gas companies have adopted their own methods of applications for using Report No. 2, and in some cases groups of companies have adopted standard work methods such as Bulletins TS-353 and TS-402 of the California Natural Gasoline Assn., which are titled, respectively, "Tentative Standard Procedure for the Measurement of Natural Gas with Orifice Meters" and "Tentative Standard Procedure for the Determination of the Corrected Hourly Gas Coefficient (C′) Used in the Measurement of Natural Gas by Orifice Meter."

Recent developments

The data in AGA Gas Measurement Report No. 2 were considered to be satisfactory until new developments in orifice metering indicated the need for additional test work. During the year 1948, the joint AGA-ASME committee on orifice metering planned a new research project which was an extension of former research work. The new work was to develop further information on the installation requirements of orifice metering with particular reference to the effects on measurement of the following:

1. Globe valves and expansion bends.
2. Plug valves.
3. Elbows between a valve and the orifice.
4. Comparison of orifice meter fittings and regular orifice flanges.
5. Size and location of pressure tap holes.
6. Internal surface characteristics.

Tests were conducted on 2-in., 4-in., and 8-in. pipelines using natural gas, steam, and water as the flowing fluids. For certain phases of the program steam or water was the most convenient test fluid. Results on tests with steam and water were translated into gas terms for use in reaching final conclusions.

Test locations were arranged as follows:

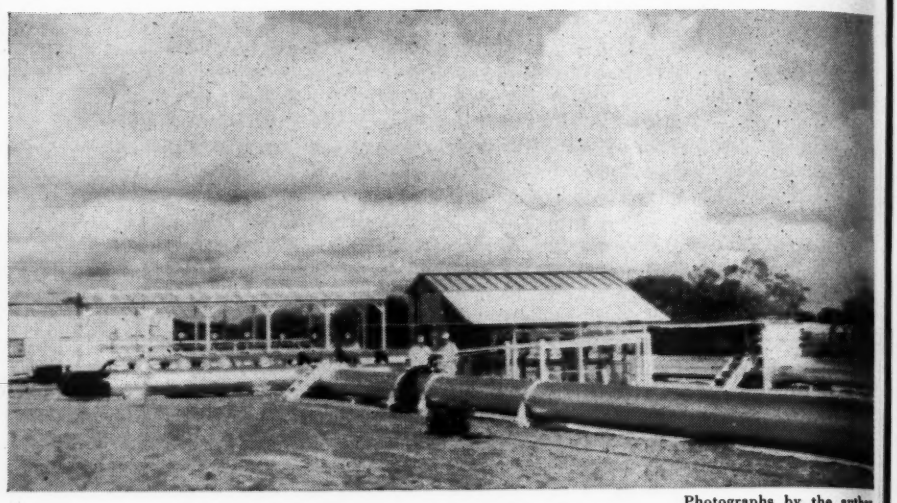
Gas—at the Rockville (Md.) natural gas metering station through the cooperation of the Virginia Gas Transmission Corp.*

Steam—at the Naval Boiler and Turbine Laboratory, Philadelphia (Pa.) Navy Yard, through the cooperation of the Bureau of Ships, U. S. Navy, who were particularly interested in the effect on orifice measurement of globe valves and expansion bends.

Water—through the cooperation of the U. S. Department of Commerce, National Bureau of Standards at the Hydraulics Laboratory, with special reference to pipe roughness.

The test work on this project has been completed. An Interim Research Report No. 1, with the title "Investigation of Orifice Meter Installation Requirements" was issued in March 1951, and a second interim report will be issued soon. These reports include results of tests only and do not draw any conclusions. Conclusions reached based on this research project will be included in a revision of AGA Gas Measurement Report No. 2, which is being prepared under the direction of the AGA supervising committee for Project NX-7, "New Orifice Metering Report." It is expected that this new report will include installation specifications for plug valves, orifice fittings, and the finish of the interior surface of orifice meter runs.

*See "Preliminary Test Results in AGA-ASME Rockville Orifice Research," by Mr. Partridge published in the April 1950 issue of *GAS*, pages 75-81.



Photographs by the author.

Overall view of test site, with 30-in. orifice flange in center, 30-in. orifice fitting at right, 10-in. reference tubes in background with gauge house.

The orifice meter tests at Refugio

Prior to the publication of the AGA Gas Measurement Committee Report No. 2, an exhaustive set of tests was conducted to accurately calibrate orifice plates in pipes ranging in diameter up to 14 in. With the advent of large high pressure transmission lines, there has been an increasing need for large diameter orifice meters to measure the enormous quantities of gas moving through the lines.

In May 1951, in response to numerous requests, AGA and ASME decided to conduct a series of tests to determine the feasibility of measuring gas by means of large diameter orifice meters. A special subcommittee on large orifice meters was appointed under the chairmanship of E. E. Stovall, Lone Star Gas Co., to conduct this work.

A test site was located near Refugio, Texas. It is connected to the large gas transmission lines owned and operated by the Tennessee Gas Transmission Co. It consists of one 30-in. meter equipped with a set of conventional orifice flanges, eight 10-in. meters with orifice flanges, and one 30-in. meter equipped with an orifice fitting. Tests were conducted during June, July, November, and December 1952 and also during May, June, and July of this year.

A preliminary computation of results has indicated that the data in AGA Report No. 2 can be extrapolated for use on larger diameter meters with approximately the same degree of tolerance. It is anticipated that the data obtained from this project will be included in the "New Orifice Metering Report" now being prepared for publication by the AGA.

It is hoped that data derived from this research program will furnish industry with information that will enable it to operate the many large and long transmission lines more efficiently with more accurate measurement of the gas. Good

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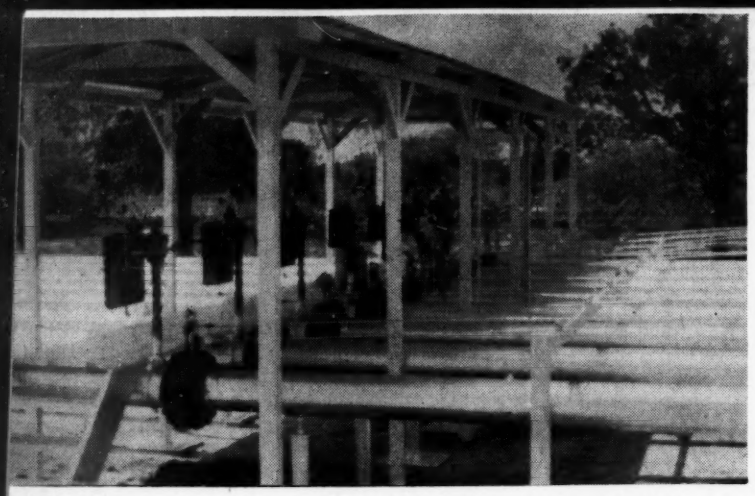
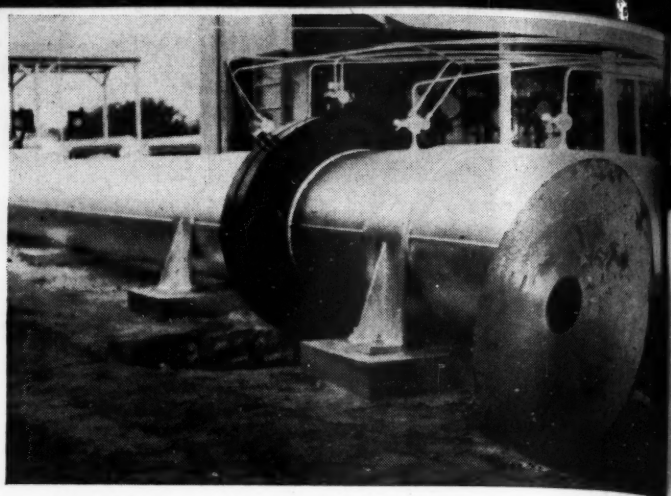
When you plan your next pipeline protection job, figure it *two ways* . . . one with Galvo-Line. Let the facts prove themselves. THE DOW CHEMICAL COMPANY, Midland, Michigan.

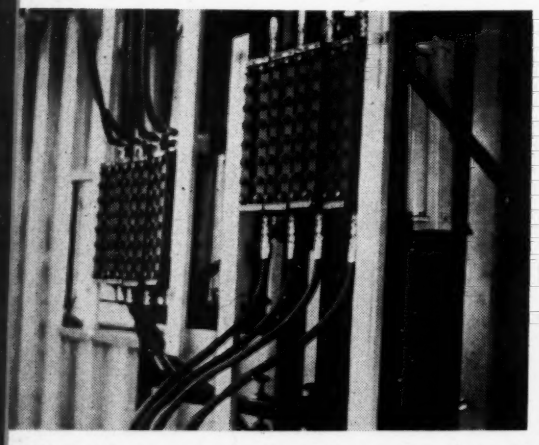
you can depend on DOW MAGNESIUM ANODES

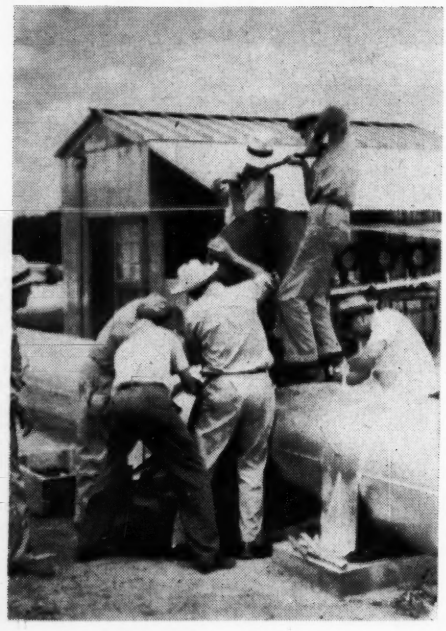
DOW





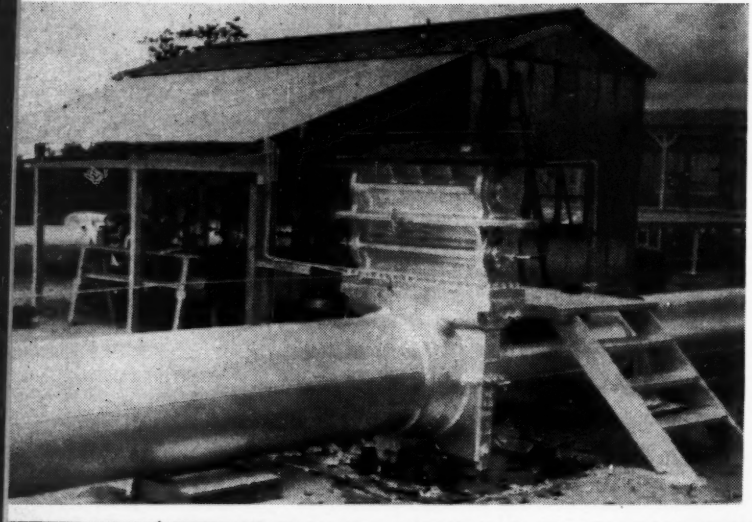
Above: Ten-in. reference tubes and recording differential pressure gauges used for comparison with official water manometers. **Below:** Water manometers inside gauge house by which the differential is read by about 12 synchronized cameras.





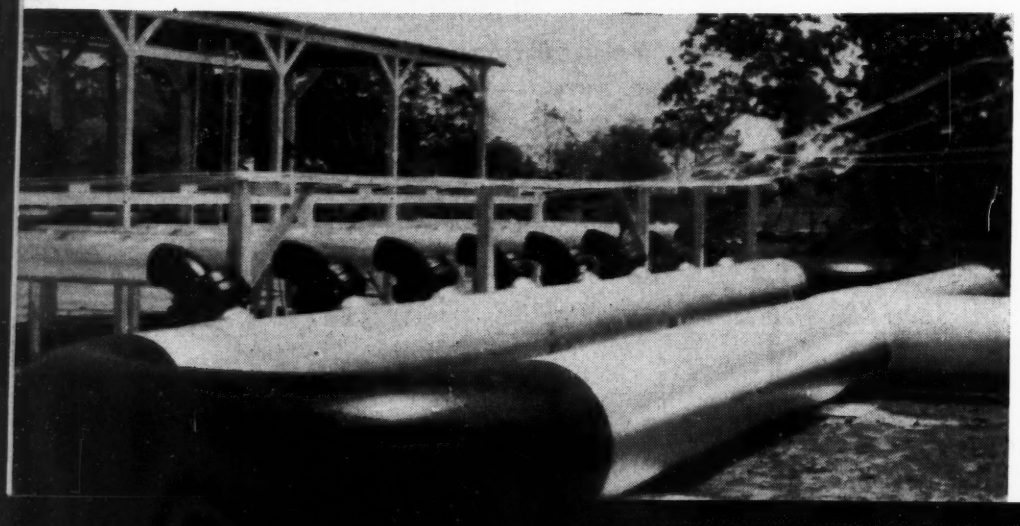
Above: Thirty-in. orifice flange union and 30-in. x 7½-in. orifice plate. This is the smallest size tested (.245 Beta ratio). **Left:** Crew installing orifice plate in 30-in. flange union.

Views of Refugio's orifice meter test facilities



Thirty-in. senior orifice fitting and gauge house in which differential manometer was installed with photographic equipment for recording test data.

Thirty-in. continuous header designed to equalize the flow through the eight 10-in. reference meter tubes.



metering will furnish valuable operating information to dispatchers, will indicate when cleaning is necessary to restore pipeline efficiency and permit better control of line loss and many other problems encountered with the handling of large volumes of gas through high pressure transmission lines.

Determination of deviation factors for natural gas

In high school physics we are taught that a perfect gas will behave in accordance with Boyle's law, which states that as the pressure is increased the volume is decreased proportionally. While, of course, natural gas is perfect for heating, cooking, and freezing, it does not exactly conform to Boyle's law when subjected to high pressures. This deviation, which has sometimes been called supercompressibility or superexpansibility, has been the subject of considerable study. It is the one factor used in gas measurement by orifice meter that cannot be determined by the use of AGA Gas Measurement Report No. 2. It has been generally determined by actually testing spot samples of the gas.

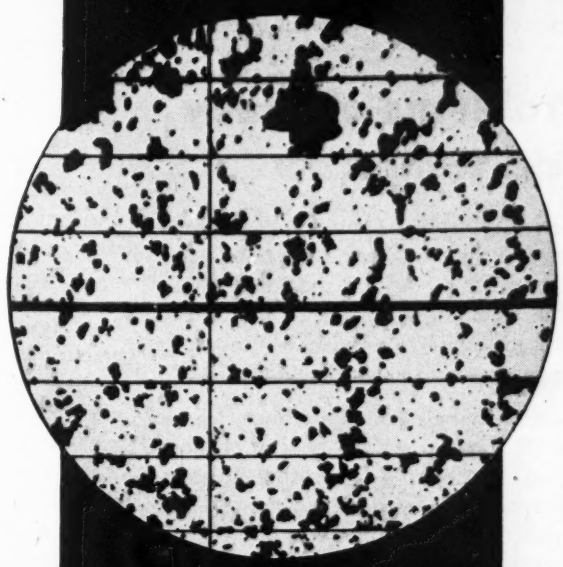
In response to numerous requests, a supercompressibility research group was set up at Ohio State University under the sponsorship of some of the large gas companies. This group, under the supervision of Prof. Samuel R. Beitler,* has completed the development of a method

*See "A Working Method for Predicting Supercompressibility Factors" by Professor Beitler and Richard H. Zimmerman in the October 1952 issue of *GAS*, pages 129-137.

Removal of Large Micron Dust Particles IS NOT ENOUGH!

BLAW-KNOX GAS CLEANERS

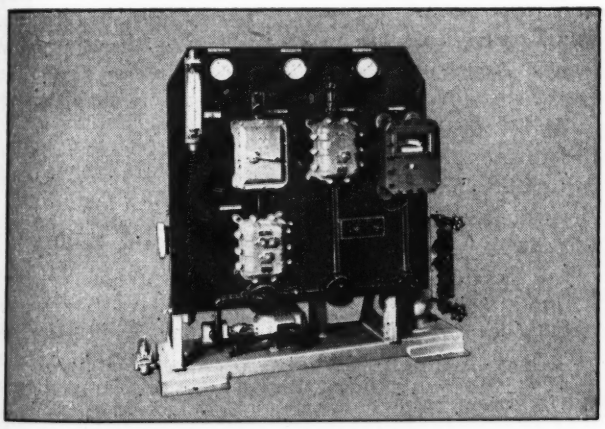
take out the SMALLEST PARTICLE of pipe line dust



Repeated tests have proved it's the *small* dust particles which cause the most trouble and damage in gas systems. Pilot stoppages, for example, are caused by dust particles ranging in size from 10 microns to less than one micron.

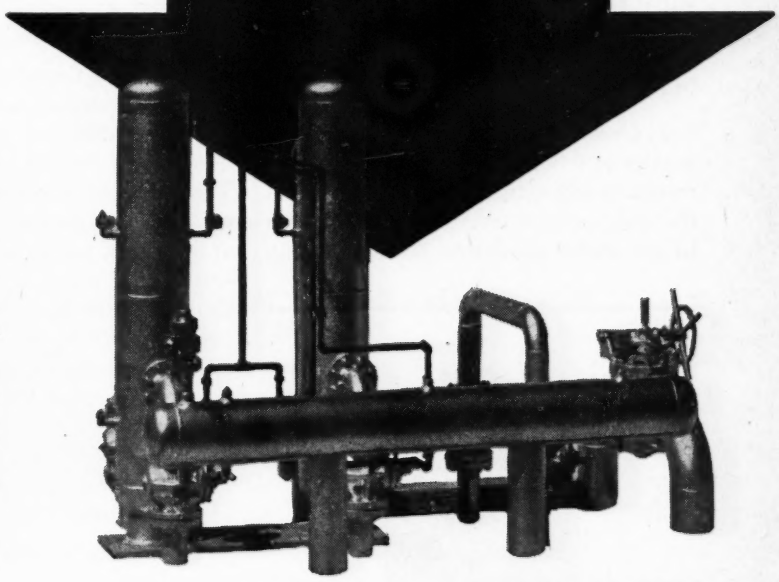
OIL BATH SCRUBBING

is the only gas cleaning method definitely known to remove even the smallest dust particles from gas. Blaw-Knox Oil Bath Process Gas Cleaners give you much more than a high percentage of dust removal —they clean out the smallest particle of dust from your gas stream and effectively stop plugging of pilot orifices and damage to regulators, compressor parts and metering devices. They cut maintenance and service costs and improve customer relations by providing *clean* gas at all times. For complete information, write for Bulletin 2353.



BLAW-KNOX ELECTROIL FOGGER

These approved units are now fogging millions of cubic feet of gas hourly. They are made in standard and portable sizes.



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PITTSBURGH 22
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whereby these deviation (or supercompressibility) factors can be very accurately predicted from known characteristics of the gas. It is hoped that the results of this work can also be included in the New Orifice Metering Report.

Problems of today and tomorrow

Even with the completion of the present research projects and the publication of the resulting reports, there will still be some troublesome problems to contend with in connection with orifice meter measurement. Some of these are:

1. Pulsating flow. Pulsations in the gas stream are set up by compressors, liquid in the lines, pressure regulators, and sometimes by unknown causes, all of which may seriously affect the accuracy of orifice meter measurement in an unpredictable manner. Either the development of some method of measuring the pulsating flow or preventing the pulsations from reaching the orifice meter will require more information than is at present available. Additional research is needed to develop procedures to determine just how much pulsation is permissible without causing errors in measurement. With the exception of installation conditions, it is probable that the determination of errors due to pulsation has been the largest source of difficulty in flow measurement.

2. Gravity variations. A change in gravity of 0.05, which is not uncommon, results in approximately a 4% change in the orifice coefficient. The measurement of gas under conditions of widely varying gravity presents a serious problem at the present time. Some means of either compensating for changes in gravity or eliminating the need for a gravity factor is needed.

3. Extreme flow variations. The orifice meter is usually flexible enough to measure gas with a 1 to 3½ variation in rate of flow. This range can be greatly extended by the use of multiple gauges and/or multiple tubes, but there is still a measurement problem existing where a large consumer cuts down to the equivalent of pilot light usage only.

4. Automatic boiler controls. The practically instantaneous turn-on and turn-off of large boiler loads at short intervals (of the order of one minute) result in almost unreadable orifice meter charts due to the relatively fast movement of the differential pen. This problem has been met in the past by resorting to volume chambers, fast charts, averaging the chart reading, and to a lesser extent by using an integrating type of meter.

These and other similar problems present a continuing challenge to those dealing in large volume measurement. With continued support of the industry, the various gas measurement men will eventually work out these problems by means of future new research projects in a manner similar to the above reported projects that are now being completed.

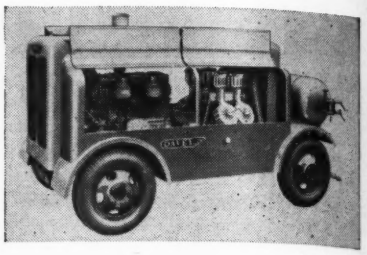
Even with the solution of the problems just outlined there is still a wide field for continuing progress and development in the gas measurement field. The ultimate objective is, of course, to maintain the highest practical accuracy at the lowest practical cost. It is possible that in the future a new orifice meter gauge will be developed at a reasonable cost that will be self-compensating and self-integrating, so that it will be only necessary to read the index at the end of each billing period and use the result obtained without the necessity of applying the numerous factors that are now in general use.

To summarize, the primary desire of all measurement engineers is to measure gas as accurately as possible. With the additional experimental information now at hand, the measurement engineers will have the advantage of greater knowledge with which to assist the industry in its control of transmission gas pipeline operations. It is anticipated that resulting benefits will far exceed the cost of such a research program.

Mr. Partridge is a gas measurement engineer at Southern California Gas Co. in Los Angeles. He participated in the AGA-ASME orifice tests in 1949 and at present is an active member of the AGA gas measurement committee.

New Products

For additional information on these products use coupon on p. 52.



25 Portable Compressor

Davey Compressor Co. has announced a new unit, the largest in its line, known as the Super Chief 600. The 600 cfm diesel-powered portable compressor has four low-pressure cylinders with 8-in. bore and 4-in. stroke and two high pressure cylinders with 6⅝-in. bore and 4-in. stroke. The 4-wheel trailer style shown measures 150 in. long, 75 in. wide, and 95 in. high. It is also available skid mounted, with dimensions of 150 in. by 63 in. by 69 in.

Standard features include automatic compressor-engine controls; individually finned, separately replaceable cylinders; full force-feed lubrication; cast aluminum crankcases; multi-port valves; automotive type steering; full spring suspension and double, built-in, full length tool boxes.

Davey Compressor Co.

■

Trade Literature

26 Manometer Bulletin

A new bulletin issued by Trimount Instrument Co. tells of the firm's Red Line manometers. It illustrates the company's well type manometers, absolute pressure manometers, U-tube manometers, indicating flow meters, orifice flanges and plates.

Trimount Instrument Co.

■

27 Lubricated Plug Valve Booklet

A booklet describing its new line of lubricated plug valves is now available from Ohio Injector Co. It covers the steel and semi-steel valves designed for working pressures from 175 psi to 800 psi, showing sectional views of the various sizes and containing dimension tables that are keyed to the diagrams. An entire section of the booklet is devoted to accessories such as: remote control devices, wrenches, locking devices, adaptors, socket wrenches and extensions. Specifications are included for floor stands, chain wheels, pressure relief valves, water tight gear housings, and road boxes. It also contains guidance tables for proper lubes at specified temperature ranges.

Ohio Injector Co.

GOING PLACES...ON TIME!

In less than four years we've shipped more than 22,000 carloads of Basalt-Kaiser Steel line pipe to the nation's growing pipeline networks . . . all of it delivered on time.

This high strength, large diameter pipe of highest quality is playing an important role in the transmission of gas, oil, and water throughout the country.

Experienced pipeline companies know they can rely on Kaiser Steel's uniform quality, prompt service, and wide range of sizes—all good reasons why . . .

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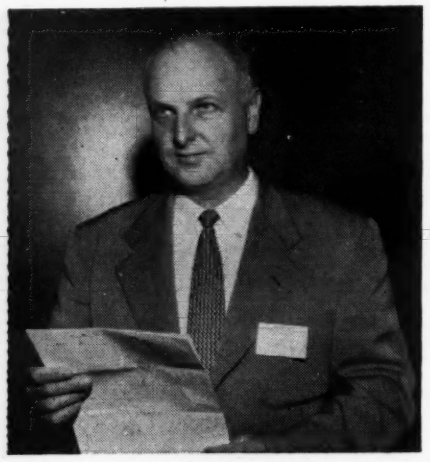
KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York

PIPELINE NEWS



Jerome K. Kuykendall

Faster rate processing promised by Kuykendall

"We believe that adequate regulation of your industry can be given by temperate and considered, yet firm and decisive, action on our part, and that harassment and intimidation are not necessary or proper tools of a regulatory agency."

In these words, Jerome K. Kuykendall, new chairman of the Federal Power Commission, enunciated the philosophy of the commission as it will affect gas utility regulation under his administration. His remarks were made before the annual meeting of the Independent Natural Gas Assn. of America at Houston Sept. 29.

Devoting the majority of his address to the ubiquitous question of rates, Mr. Kuykendall took note of the widespread belief that FPC is keeping an over-all ceiling on the rate of return "and that the ceiling was recently raised."

"The commission," he declared, "has not set an arbitrary ceiling or floor above or below which it will not go. To do so would, in our opinion, not be consistent with either the letter or the spirit of the Natural Gas Act which requires us to fix just and reasonable rates. In other words, we must exercise our judgment unhampered by arbitrary, self-imposed restrictions which might be in conflict with the legislative standards that govern us. . . .

"The pertinent facts concerning and surrounding different natural gas companies may justify and, in our best judgment, require varying rates of return . . ."

FPC is cognizant of the seriousness of the regulatory lag, he assured his listeners. Congress, too, has recognized it by increasing appropriations (despite cuts in allocations to other agencies) to enable FPC to flesh out its staff.

While this goal is being achieved (slowly, because of red tape and lack of experience on the part of new staffers), "mere enlargement of the staff in itself will not provide a solution," he said.

One other forward step was taken when FPC adopted new rate filing regulations last July, including the stipulation that considerably more data must be submitted with the filing. "Although these regulations place a burden on you at an earlier period of the proceedings than did the former procedure, we believe that experience is showing . . . that the total period of time required to process a case may be materially shortened.

"Some of you are of the opinion that unnecessary information is being required. The commission is ready to eliminate any requirements that are shown to be unnecessary," he promised.

While the commission is developing procedural short cuts and straining to shorten delays and continuances, utilities should show restraint in selecting evidence for presentation. "Rate hearings . . . are not held to provide opposing counsel with an arena in which to cultivate their respective histronic talents nor to vie in achieving surprise over each other."

Mr. Kuykendall hailed the recently popular "conference method" of settling rate cases, in which applicant and intervenors meet with the staff to work out rate compromises and so cut short formal hearings.

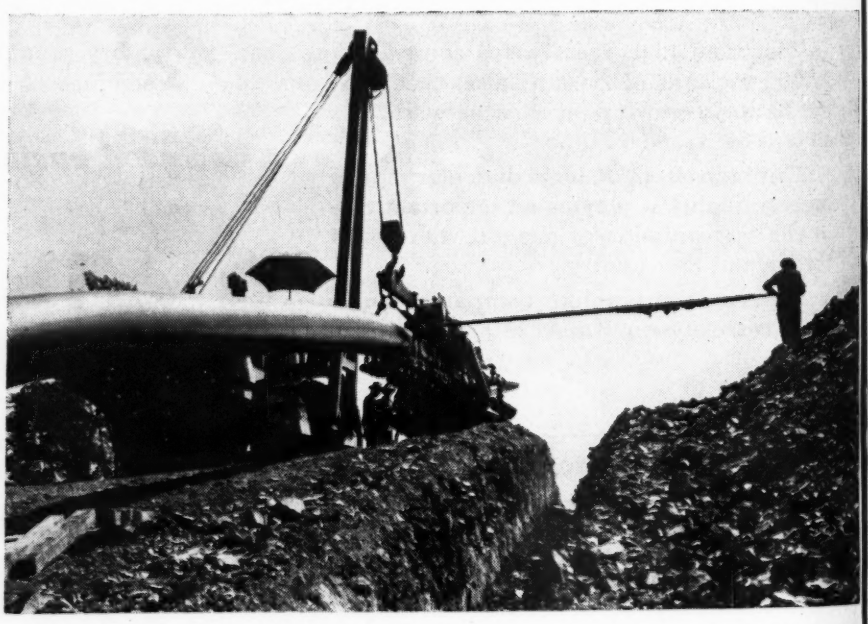
Mr. Kuykendall, who declared he was reporting the views "of all the members," said a majority of the commission favors passage of the Hinshaw bill (HR 5976) to exempt intrastate utilities from its jurisdiction.

Three firms petition for certificate changes

Three companies have filed two petitions with FPC to change pipeline projects previously approved for construction in Texas. El Paso Natural Gas Co. has asked permission to change arrangements under which Permian Basin Pipeline Co., Omaha, would transport gas for El Paso from the Spraberry Trend in Texas. The other petition, filed jointly by El Paso, Permian and Northern Natural Gas Co., Omaha, asked authority for certain operational changes under which gas delivered to El Paso by Permian will become the property of Northern before being transported through El Paso's facilities.

El Paso's petition would effect its expansion program, approved last June, planned to increase its system capacity by 400 MMcf daily. It has made an agreement with Permian under which that company would transport up to 225 MMcf per day from Spraberry to El Paso's proposed Plains compressor station in Yoakum county, Texas. This plan calls for the redesigning of facilities in the Spraberry area, which would eliminate the necessity for duplicate systems. The redesigning, El Paso said, would provide greater flexibility of operation and result in lower operation and maintenance costs, and lower construction costs, savings El Paso $5,844,910.

The other petition filed jointly by the three companies relates to certificates issued May 1, authorizing the construction of facilities to make additional gas available to Northern. As authorized, Permian is to deliver gas to El Paso at Wasson, Texas with El Paso delivering an equivalen



A coating and wrapping machine is silhouetted atop a mountain near Birmingham, Ala. as H. C. Price Co. engaged in the construction of 200 miles of 24-in. loop and new lines which was completed last month for Southern Natural Gas Co. The lines are part of system to extend service to new and existing markets in four southern states.

If Henry Hudson could see it now...

DELAWARE U·S·A VALLEY

To Henry Hudson who first explored it, the Delaware River was a possible passage to the wealth of the Indies. Little could he have foreseen that on the banks of this great river there would one day arise an industrial empire that would surpass even his wildest dreams of Eastern riches.

Delaware Valley, U.S.A. it has come to be known —America's fastest growing industrial area—a cross section of both the nation's industry and many of its best known names.

CF&I is proud that its steel and steel products mill at Claymont, Delaware is located in the Delaware Valley. Our future plans for expansion of production facilities will contribute still further to the development of this "valley of opportunity."

1971

CLAYMONT STEEL
CF&I

Conclusions favorable to sleeves seen in girth weld test report

IN the June issue of *GAS** G. B. Grable and G. M. McClure described tests performed at Battelle Memorial Institute under the sponsorship of five gas pipeline companies for the purpose of evaluating the performance of sleeve reinforcements for girth welds.

Compliments are due the authors for having obtained unquestionably valid experimental data which are of importance in understanding the role played by sleeve reinforcements. However, two aspects seem to require further discussion.

The authors would probably agree that the tests they report are laboratory tests rather than field tests. Under strictly controlled conditions, they tested behavior under known combinations of bending moment and internal pressure. No other variable conditions were tested, except that two of the girth welds were "sound," one was "leaky," and one was missing. How many variables must be reckoned with under field conditions? Who can say? No one knows better than gas pipeline engineers just how much difference there may be between laboratory conditions and actual field conditions, and how few of the important variables may be studied in the laboratory.

Even so, the laboratory results are of great interest. The general conclusions listed by the authors do not follow from their test data, but instead represent rather subjective opinion with the implications of which there is ample room for disagreement. Let us here briefly summarize the important data obtained from the four tests to destruction reported by the authors, bearing in mind that inevitable differences between test specimens account for a reasonable percentage margin of variation in results. The four tests (to destruction) are:

No. 1. With reinforcing sleeve. Girth weld *omitted.* Failed under internal pressure of 1565 psi.

No. 2. With reinforcing sleeve. Leaky girth weld. Failed in pipe body away from joint under internal pressure of 1600 psi.

No. 7. With reinforcing sleeve. Sound girth weld. Failed under bending load (20-in. deflection) and 1650 psi internal pressure.

No. 8. Without reinforcement. Sound girth weld. Failed under bending load (20-in. deflection) and 1660 psi internal pressure.

These results support the following conclusions:

1. All four tests to destruction took place under substantially the same internal pressure—approximately that required to burst the parent pipe.

2. Application of bending moment sufficient to cause substantial yielding does not decrease the internal pressure required for failure, but may actually increase it.

3. No difference is observable between the internal pressure required to cause failure in reinforced or unreinforced girth joints of sound construction which have been subjected to a bending moment sufficient to cause substantial inelastic yielding.

4. Even though the girth weld is faulty (or entirely absent), a joint equipped with a reinforcing sleeve is capable of sustaining the same pressure as a sound girth weld, with or without reinforcement.

Thus, generally, if the girth joint is absolutely sound, the reinforcing sleeve is not necessary (under the Battelle test conditions), but its use does not decrease the strength of the joint. If the girth joint is not sound, the reinforcing sleeve is capable of providing the strength and soundness which is desired but which is not provided by the girth weld. These conclusions are based solely upon the Battelle laboratory tests; actual operating experience under field conditions supplies many other reasons why satisfied users continue to specify reinforcing sleeves.

John E. Brock
Midwest Piping Co. Inc.
St. Louis

*"How Well Do Girth Weld Sleeves Resist Loading and Bending Stresses?" appearing on pages 87-89.

amount to Northern at Dumas, Texas, for the account of Permian. Under the proposed operational change, Permian would deliver the gas to Northern at Wasson, with Northern immediately delivering the gas to El Paso at this point. El Paso would then transport the gas for the account of Northern, rather than Permian, and would redeliver equivalent volumes to Northern at Dumas. This would eliminate the necessity for Permian to construct a measuring station at Dumas.

Work on Gulf Interstate line well under way

With more than 200 miles already completed, the first gas pipeline devoted solely to the transmission of gas between a producer and its distribution center (see October *GAS*, page 126) is well under way between southern Louisiana and a connection with United Fuel Gas Co. lines supplying Ohio, Pennsylvania, and West Virginia, and portions of adjoining states.

Target date for completion of the Gulf Interstate Gas Co. line (FPC docket G-2058) is Nov. 1, 1954. It is estimated that more than 500 miles of the 866-mile 30-in. line will be finished by Christmas of this year. At the moment work is going ahead on six spreads. H. C. Price Co., Bartlesville, Okla., and Houston (Texas) Contracting Co. are the contractors for the mainline work. Gathering lines are under construction by Williams Bros. Co., Anderson Bros. Corp. and Associated Pipeline Contractors Inc.

In the five compressor stations, totaling 40,000 hp, reciprocating machines will be installed with three Cooper-Bessemer installations and two Clark-equipped stations.

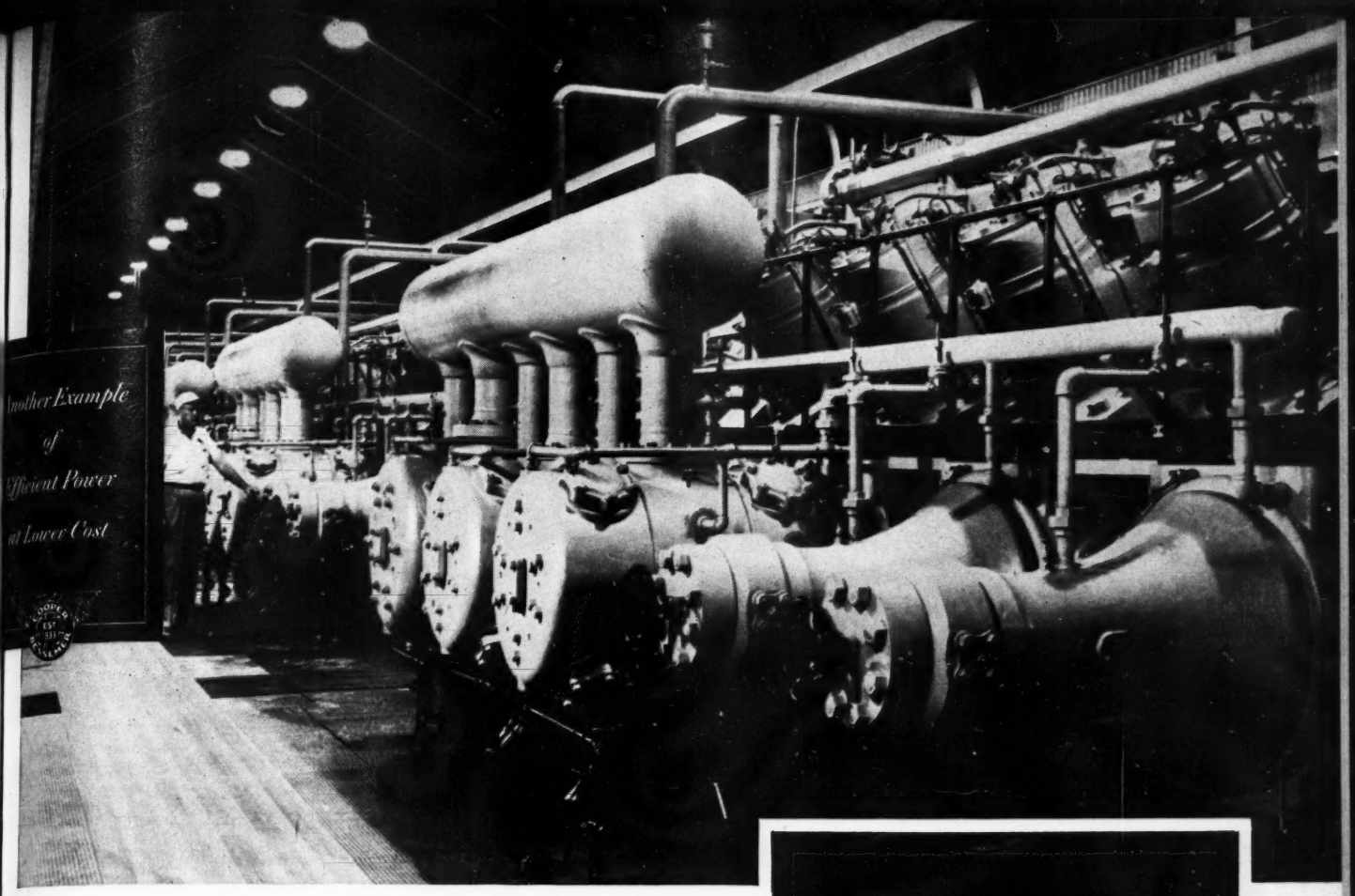
Gulf Interstate is headed by Hy Bird, who is also president of Trunkline Transmission Co. of Houston. Other officers are F. S. Young and Sam Taylor, vice presidents; G. N. Woodfin, vice president and secretary; J. A. Staples Jr., assistant secretary and treasurer; and W. A. Koros, assistant treasurer. The company has temporary headquarters in the M & M building, Houston.

New flood of rate cases deluge FPC headquarters

The usual chain reaction on the rate scene was touched off last month by a proposed $6,510,000 increase by Tennessee Gas Transmission Co., Houston, which the FPC suspended, while it granted a $4,592,806 annual increase to Texas Eastern Transmission Co., Shreveport, La. Tennessee Natural Gas Lines, Inc., Nashville, was granted a substitute increase of $224,127, filed in lieu of a proposed $353,764. It has been ordered to refund the difference in amounts collected since March 27. Also accepted was a $17,618 annual reduction in the revenues of Lake Shore Pipe Line Co., Ashtabula, Ohio, directed by previous FPC order.

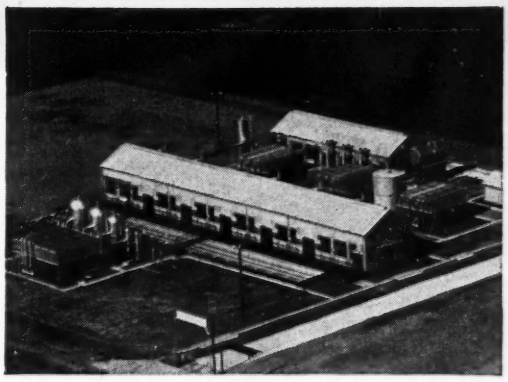
Following the Tennessee Gas action, these applications of its customers were suspended: $120,200 for Alabama-Tennessee Natural Gas Co., Florence, Ala.; $86,000 for Lake Short Pipe Line Co.; and $227,000 for Tennessee Natural Gas Lines Inc. In addition, proposed increases for two Colorado companies, Colorado Interstate Gas Co., Colorado Springs, and Colorado-Wyoming Gas Co., Denver, for $6,508,000 and $473,500, respectively, were suspended.

Tennessee Gas' requested increase was cited by United Fuel Co., Charleston, W. Va., in its application for a $2,204,000,



Line-up of six 4-stage GMV's, totaling 6,850 horsepower, in Willamar Pressure Maintenance Plant. First two stages compress 50-pound gas to 300 pounds. This gas and 300-pound field gas is then compressed for injection to 3,000 pounds absolute in remaining two stages.

Willamar Pressure Maintenance Plant, Willacy County, Texas; engineered, designed and constructed by O. L. Olsen Co., Houston; operated by Pan American Production Co., under unitization agreement.



PRESSURE MAINTENANCE AT WILLAMAR...WITH *GMV's*

...Another big step in gas conservation

In the summer of 1951 flares were killed throughout the Willamar West field and Cooper-Bessemer GMV-angle compressors went on the line in one of the biggest repressuring jobs of its kind. Starting with 6 GMV's totaling 6,850 horsepower, and an initial capacity of 33 million cubic feet of gas a day, it is another important step in conserving Southwest Texas gas. The plant is designed for easy and economical expansion to an ultimate capacity of 58 million cubic feet a day.

A feature of the ultra-modern Willamar plant is its extreme flexibility. It permits efficient operation under widely varying conditions of gas pressure and volume — a decided advantage due to uncertainties in the trend of the field's gas production.

And, speaking of flexibility, that's also a long-recognized GMV feature — one that *often* permits big savings in meeting initial and subsequent requirements. But get the *whole* GMV story. It makes sense in dollars saved and performance gained in *all* kinds of compressor service.

MOUNT VERNON, OHIO

COOPER-BESSEMER

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New York • Chicago • Washington • San Francisco • Los Angeles • San Diego • Houston • Dallas • Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis • Gloucester • New Orleans • Shreveport
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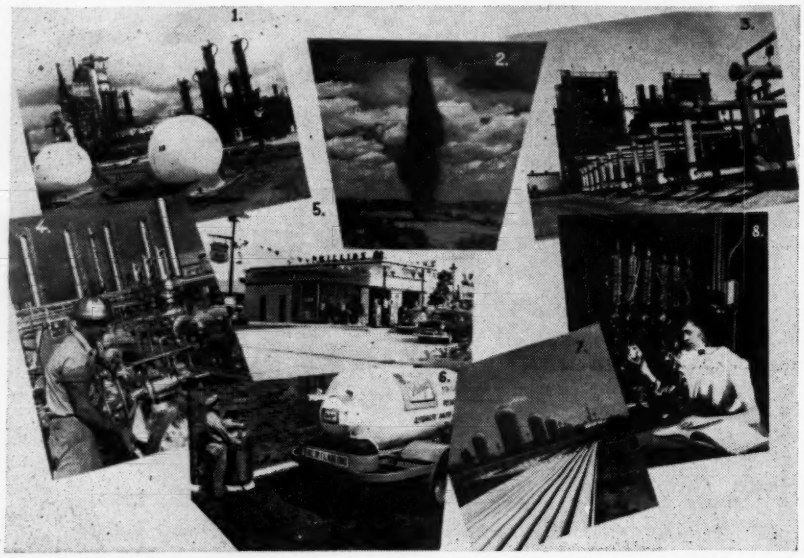
DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS • HIGH PRESSURE LIQUID PUMPS



Among Phillips' activities are (1) catalytic cracking and hydrofluoric acid alkylation units; (2) exploration and development; (3) furnace oil carbon black production; (4) natural gas liquid extraction; (5) motor fuels; (6) L.P. gas producing and marketing; (7) long-distance pipeline hauling; (8) product and process research.

Phillips assets hit $1 billion

THIRTY-SIX year old Phillips Petroleum Co. of Bartlesville, Okla., has just become the 30th corporation in American industry with total assets in excess of $1 billion.

In the past five years alone Phillips has more than doubled its size, and it is nearly four times larger than it was 10 years ago. During this period, Phillips' rate of growth has been the greatest of any of the billion-dollar companies, which include 10 oil companies. Its span of 36 years from beginning to the billion-dollar level is the shortest time required by any oil company not having predecessor companies with large integrated operations. Founded in 1917 with 27 employees and assets of $3 million, it is manned today by over 23,000 employees and owned by more than 85,000 stockholders.

Early in its history Phillips pioneered in developing commercial uses for casinghead gasoline and for many years has ranked first as a producer of natural gas liquids and as a producer-marketer of L. P. gases. In 1927 the company acquired its first refinery and in 1930 it pioneered with construction of the first long-distance pipeline for simultaneous transportation of a number of refined products, a project which revolutionized petroleum product transportation. Today the company operates seven refineries which can process a quarter of a million barrels of crude oil per day.

Over the years Phillips built and guarded its gas holdings for future high-value markets and now is considered to have the largest proved natural gas reserves of any company and ranks first as a producer and gatherer of natural gas.

Recognizing the enormous possibilities of oil and gas as a chemical source, Phillips was ready, early in World War II, with new, economical processes for the production of synthetic rubber from butane and superior furnace carbon blacks from oil. It designed, built, and operated the first butadiene plant and the first oil furnace carbon black plant.

Five years ago Phillips' chemical operations were expanded into large-scale manufacture of nitrogen fertilizers from natural gas. The company is also a major supplier of raw materials, chemical intermediates, and finished chemical specialties in such fields as synthetic fibers, plastics, solvents, agricultural chemicals, and high-purity hydrocarbons.

3½%, annual increase. Three other Columbia Gas System subsidiaries followed their supplier, United Fuel. These applications for a total of $749,600 yearly increase were filed by Atlantic Seaboard Corp., Virginia Gas Transmission Co. and Central Kentucky Natural Gas Co. Two companies serviced by Virginia Gas—Commonwealth Natural Gas Corp., Richmond, Va., and Roanoke (Va.) Pipeline Co.—are also seeking increases totaling $35,000. These were all subsequently suspended.

Ohio Fuel Gas Co., Columbus, has asked for a $1,419,000, or 7.6% increase; Natural Gas Pipeline Co. of America, Chicago, filed for $7.2 million, or 21½%, additional, citing increased cost of gas from their suppliers; and Hope Natural Gas Co., Clarksburg, W. Va., asked a $2.1 million, or 5.7%, increase based on cost of both produced and purchased gas.

Previously suspended rate increases for Southern Natural Gas Co., Birmingham, for $3,168,000 and Southern Tier Gas Corp., Watertown, N. Y., for $9,800 became effective under bond. United Gas Pipe Line Co., Shreveport, has been directed by the FPC examiner to file accounting adjustments totaling $2,836,293 due Mississippi River Fuel Corp.

Petitions for rehearing were granted in part to United Fuel Gas Co., Charleston, W. Va., and Dec. 1 has been set as the date for hearings to begin on a suspended increase totaling about $1,749,000 annually for United Natural Gas Co. of Oil City, Pa.

Contract for $300 million line let to New York firm

Contract for the gigantic $300 million natural gas line project of two 30-in. lines beginning in Texas and Louisiana and terminating in the Great Lakes and New York areas has been awarded Petrol-Structors Inc. of New York. This announcement was made by Frank Roder Smith of New Orleans, executive secretary of the Houston Texas Gas & Oil Co.

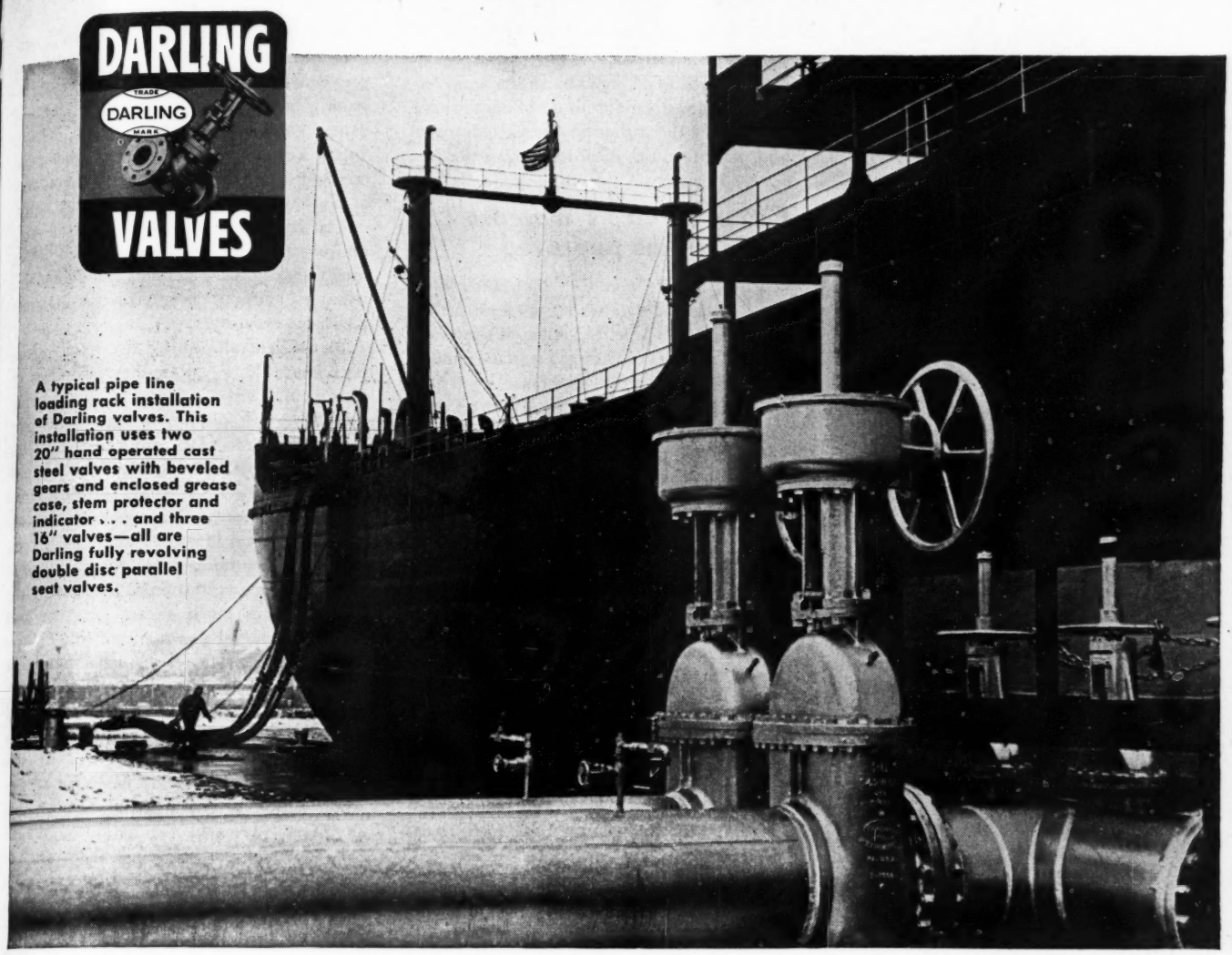
As *GAS* went to press, application was expected momentarily to be placed before FPC.

The huge system would consist of two lines converging in northern Mississippi and running parallel to a point in Ohio where they would branch again. (See August *GAS*, page 108.) Mr. Smith said the New York firm would perform the complete engineering work on the system, which would be completed within 18 months of approval by FPC. Other board members include Charles M. Rogers, New Orleans, and Glenn McCarthy, Houston.

Flaring in Texas cut by 75% from January to June

The Texas Railroad Commission reports that, although it took some drastic measures, gas flaring in that state has been reduced by 75% in the period from January to June of this year. As much as 2%, or more than 6 billion cu ft a month, of the intake at gasoline and other processing plants had been flared. By June this was cut to slightly less than 1.5 billion cu ft.

Reduction was effected by holding down oil allowables in many fields to volumes accompanied only by such amounts of casinghead gas at the plants and lines in that field could handle without flaring. When the Spraberry Trend shutdown order was declared invalid by the state supreme court (see August *GAS*, page 104), the commission modified its order with the result that the field has been operating at a reduced rate



A typical pipe line loading rack installation of Darling valves. This installation uses two 20" hand operated cast steel valves with beveled gears and enclosed grease case, stem protector and indicator . . . and three 16" valves—all are Darling fully revolving double disc parallel seat valves.

How they help keep cargo schedules with DARLING Revolving Disc GATE VALVES

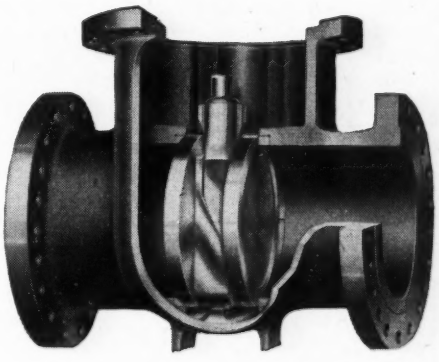
TROUBLE-FREE valve service on tanker loading racks is helping to build an enviable valve service record for Darling *fully revolving double disc parallel seat* gate valves.

The big advantage here, as in all Darling *revolving disc* gate valve installations, is the cut in down time. These unique cast steel gate valves automatically compensate for valve body distortion. Moreover, Darlings give better service longer because their *fully revolving double discs* distribute disc and seat wear uniformly. And Darling valves are always easier to operate, even under severe pressure loads or radical changes in temperature.

You save time too when it does become necessary to service Darling valves because all working parts can be replaced without removing the valves from the line. And any one, or all of the four working parts, can be quickly replaced on the spot.

Wide Range of Sizes

These Darling *fully revolving double disc parallel seat* gate valves are available in a wide range of sizes and types for all gas and oil line requirements. Ask for general descriptive literature or outline your specific service needs so we can send you the exact information you need.

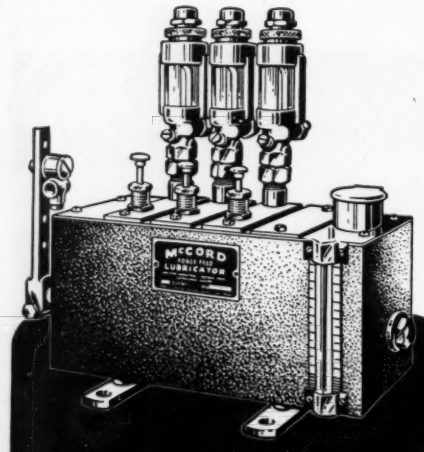


Cutaway showing the extreme simplicity of Darling's unique fully revolving double disc parallel seat gate valve principle.

DARLING VALVE & MANUFACTURING CO.

Williamsport 26, Pa.

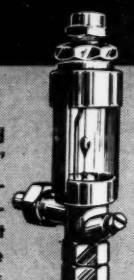
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



McCORD

Tubular "Clearsite" Feed

SF LUBRICATOR



The improved McCord Tubular "Clearsite" Feed is the latest development in lubricator visible sight feeds. Less susceptible to clouding, it carries a greater supply of liquid and may be cleaned without removing it from the pump or disconnecting it from the oil line. The McCord "SF" Lubricator provides close and accurate feed adjustments with a degree of reliability that has made this the preferred lubricator in the oil field. The advantages of easy removal of pump units, welded steel tanks, the wide variety of drives, and the new type graduated oil level gauge which provides clearer visibility are McCord features that make the "SF" Lubricator outstanding. Lubricators are in stock and deliveries are prompt.

LUBRICATOR DIVISION

McCORD CORPORATION

Detroit 11, Michigan

with wells not connected to the plants or pipelines shut down.

Construction of pipelines in the areas has been speeded up and millions of dollars have been spent on gathering lines, compressor and plant facilities in order to save the gas.

Cities Service's increase in facilities approved

Cities Service Gas Co., Oklahoma City, has been issued a certificate to construct an extension to its pipeline system to attach additional supplies of natural gas in the Golden Trend area of central Oklahoma.

Docket No. 2149, approved by the commission, covers construction of 69 miles of line and installation of one 1100-hp unit at the company's Edmond compressor station in Oklahoma county. The project includes 44 miles of 20-in. and 25 miles of 16-in. line in Oklahoma, Cleveland, McClain, and Garvin counties. Total estimated cost of the construction is $3,002,700.

The increased capacity is expected to make available nearly 40.5 MMcf of additional gas per day.

Nearly 400 register for INGAA annual meeting

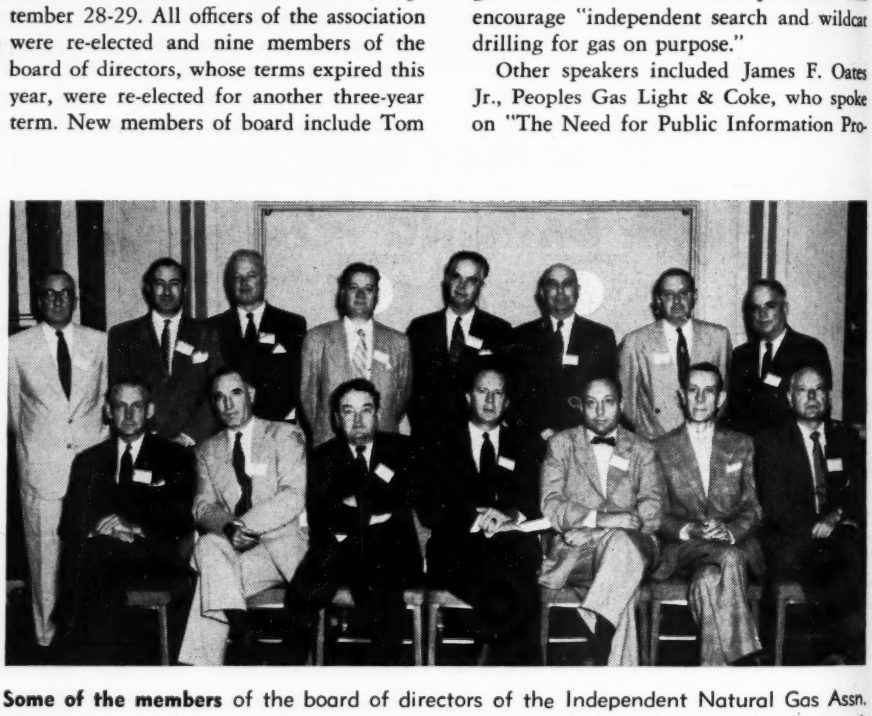
Nearly 400 conventioneers were registered for the annual meeting of the Independent Natural Gas Assn. of America, held at the Shamrock hotel, Houston, September 28-29. All officers of the association were re-elected and nine members of the board of directors, whose terms expired this year, were re-elected for another three-year term. New members of board include Tom P. Walker, Transcontinental, named to succeed Claude A. Williams, former Transco president, for the term ending 1955. F. M. Banks, Southern California Gas Co. was named to succeed H. K. Wrench, Minneapolis Gas Light Co., who resigned, and one additional director—Hy Bird, president of Gulf Interstate—was added to the board.

The first day of the program was devoted entirely to meetings of groups, including rates, taxes, legal, pipeliners, producers, distributors and public information program advisory committees.

At the general meeting on Sept. 29 members heard L. F. McCollum, president of Continental Oil Co., discuss "Exploration and Discovery of Gas in Relation to the Consumer." Mr. McCollum declared that extension of federal regulation to the production of natural gas would force producers out of business and eventually leave consumers without adequate supplies. He compared the volume demand for gas to other key industries, pointing out that gas weighs only 62% as much as air, yet "the total weight of natural gas marketed in 1952 was approximately twice the total tonnage of steel produced by all the steel mills in the United States last year."

Lt. Gen. Ernest O. Thompson, of the Texas railroad commission, echoed Mr. McCollum in discussing "The Natural Gas Contribution to Oil and Gas Conservation in Texas." He said the nation no longer can depend upon accidental discoveries of gas but must offer a wellhead price that will encourage "independent search and wildcat drilling for gas on purpose."

Other speakers included James F. Oates Jr., Peoples Gas Light & Coke, who spoke on "The Need for Public Information Pro-



Some of the members of the board of directors of the Independent Natural Gas Assn. of America at the association's annual membership meeting held at the Shamrock hotel, Houston, Sept. 29. Left to right they are, front row: H. Wildes, Republic Natural Gas Co.; J. J. Hedrick, Natural Gas Pipe Line Co. of America; S. B. Irelan, Cities Service Oil Co.; C. P. Rather, Southern Natural; J. F. Merriam, Northern Natural; D. D. Harrington, Panoma Corp.; Glenn Clark, Cities Service Gas Co. Back row: S. D. Whiteman, Kansas-Nebraska Natural; Norman Hirschfield, Consolidated Gas Utilities Corp.; F. S. Kelly, independent producer; Hy Bird, Gulf Interstate; C. H. Zachry, Southern Union; H. W. Bass, Trinity Gas Co.; Harry L. Mann, Texas Gas Transmission; John A. Ferguson, executive director of the association.

grams as Affecting Transmission and Distribution of Natural Gas."

In his annual report to the membership, association president C. P. Rather, Southern Natural, also pointed up the association's new public information program, declaring "those of us who have studied the program and the need for it are convinced we are on the right track."

Also on the program were Edward T. McCormick, president of the American Stock Exchange, and Jerome K. Kuykendall, FPC chairman. (Highlights of Mr. Kuykendall's and Mr. Oates' addresses will be found elsewhere in this issue.)

Summer gas delivery will meet alfalfa drying needs

In ordering Colorado Interstate Gas Co. to deliver a maximum of 500 MMcf of gas per year to Kansas-Colorado Utilities Inc., Lamar, Colo., FPC chief presiding examiner Edward B. Marsh pointed out that in addition to the deficiency in supply of gas which exists in the summer months only, Kansas-Colorado has been unable to supply the requirements of alfalfa dehydrating mills. Development of this business is vital to the economic growth and improvement of the company's service area.

The gas will be delivered during the months of May to October through an existing connection of the companies' systems at McClave, Colo. Kansas-Colorado had asked for a total of 920 MMcf per year, but Examiner Marsh ruled the evidence does not support a finding that it is necessary or desirable to direct Colorado Interstate to serve more than 500 MMcf yearly. He also pointed out that there does not appear to be any possibility that Kansas-Colorado could use any part of the excess above that amount.

Ark.-La. permitted to stop service to Mississippi

In a decision subject to review of the commission (dockets G-2122 and G-2155) FPC presiding examiner Emery J. Woodall has granted permission to Arkansas Louisiana Gas Co., Shreveport, to abandon the natural gas service of about 12.5 MMcf per day to Mississippi River Fuel Corp., St. Louis.

Arkansas' load growth has created a market for the gas now sold to Mississippi, Mr. Woodall said, and the discontinuance of service to Mississippi would result in economic benefits to Arkansas. Arkansas would receive more return for the gas than Mississippi now pays and availability of this gas would tend to postpone requirements for increasing the company's transmission system capacity. The decision also points out that the 12.5 MMcf represents only about 2.9% of Mississippi's annual gas purchases and that the increase in average cost of gas to Mississippi would be very slight. Mississippi had contended that the abandonment would mean a higher average cost of gas to it.

Notes

Bechtel Corp., San Francisco, has announced the sale of its Somastic division to Pipe Linings Inc., Los Angeles. All operations conducted in 11 western states and all foreign countries will now be handled by Pipe Linings. J. S. Connell, general manager of the Somastic division will remain in an advisory capacity, while Austin S. Joy, general sales manager, will move over to Pipe Linings as sales manager of that organization.

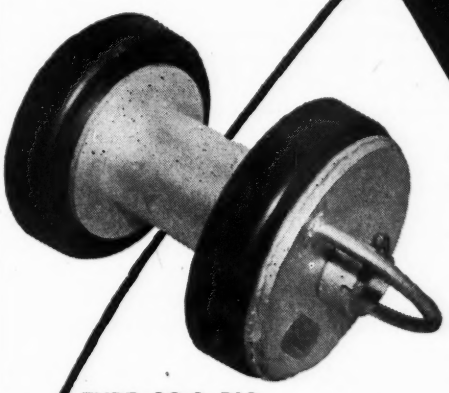
Under a revised sales policy the United States Steel Corp. will continue to quote prices f.o.b. its mills, or if the customer desires, delivered prices reflecting full transportation charges. The revised policy permits meeting a lower delivered price of a competitor when necessary and commercially desirable. Chairman of the board, B. F. Fairless said, however, this does not constitute a return to the so-called multiple basing point method of selling.

Central Kentucky Natural Gas Co., Charleston, has been granted temporary authorization to construct 8.8 miles of 20-in. line paralleling an existing line extending northward through North Means, Ky. to assure continuity of service to Cincinnati, Ohio. The line is expected to cost $706,300. The permit was conditioned to limit Cen-

the pig for GAUGING new pipelines

Pigs are propelled a mile or so at a time to assure construction inspector that pipe line is free of flat spots and other obstructions.

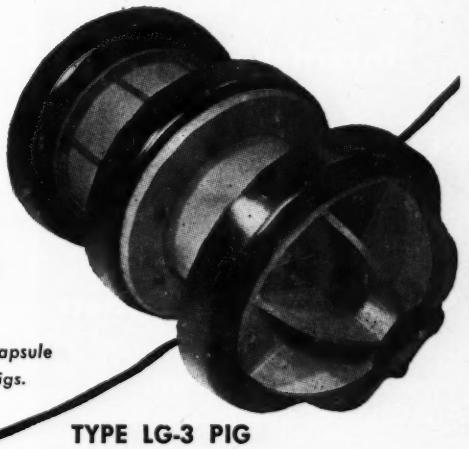
Sizes: 2" to 34"



2-Cup Design
Simplest design with Stellite-edged sizing plate on front. Cannot traverse conventional gate valves. Tough, neoprene cups have wear-compensating, flexible, tapered lip.

TYPE SG-2 PIG

3-Cup Design
More than 2 cups required for Gauging Pig to traverse gate valves and to travel long distances without excessive wear. Stellite-edge sizing plate centered for weight balance.



Special Whistles, Rattlers and Radium Capsule Holders are available for Gauging Pigs.

TYPE LG-3 PIG

T.D. Williamson, Inc.
THE PIG WITH THE POKE CLEANS PIPE LINES
P. O. BOX 4038
TULSA 9, OKLAHOMA

"There is a Pig design for your pipe-line problem."

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HOUSTON . . . PITTSBURGH . . . KENILWORTH, N. J. . . . AMARILLO . . . PROVO, UTAH
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For easy handling of coated pipe!

CROSE ENDLESS PIPE BELT SLINGS

The finest belt sling available for handling coated pipe on lowering-in operations. For pipe sizes from 8" to 36". Conventional type belt slings available for 4" to 36" pipe.

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Cleaner Pipelines Co.
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Internal Pipeline Cleaners
EXPANSIBLE RUBBER CORE
For Gas Transmission Lines

6" through 30"

Spring Loaded Cleaners
Individual Coil Springs
Under Each Brush
For Oil, Gas and Products Lines

10" through 30"

Night Caps — Squeegees

Pipeline Tools
and Other Accessories

WRITE FOR CATALOG

tral's combined deliveries to Cincinnati (Ohio) Gas & Electric Co., and Union Light, Heat & Power Co., Covington, Ky. to 305.8 MMcf daily pending final disposition of the application.

The first commercial gas well in Mercer county, W. Va., has been brought in near Athens by United Fuel Gas Co. Gas was found in the Maxon formation at 1785 ft and produced an open flow of 230 Mcf daily at a pressure of 310 lbs. An earlier well was drilled by the company on Red Oak Ridge in which gas showed at 5000 ft, but not in sufficient quantity for commercial use. United has set up a wildcatting budget of $630,000 and will drill more wells in the county.

FPC has approved withdrawal of Morganfield (Ky.) Natural Gas Co.'s application (docket No. G-1935) for a 31-mile line extending to Morganfield from a connection with Texas Gas Transmission Corp. near Providence, Ky. The line, which was planned to serve six communities, would have cost an estimated $1,075,000. The company said it had been unsuccessful in obtaining firm commitments to finance the project.

Pacific Gas & Electric Co., San Francisco, last month received authorization to construct about 11 miles of 24-in. line. A 10½-mile line will be built from its Antioch control station to its steam electric plant at Pittsburg, Calif., with a 2500-ft line connecting this line and the Standard Pacific Gas Line Inc. system at Stoneman Junction. PG&E will serve its steam electric plant on an interruptible basis through the longer line. The short line will be used for maintenance of service beyond Stoneman Junction in case of a Standard Pacific failure. Estimated cost of the project is $992,800.

Trunkline Gas Co. has been directed by FPC order of presiding examiner Francis L. Hall to supply a maximum of 2 MMcf of gas per day to Central Illinois Public Service Co., Springfield, to help it meet requirements of its service area. Central is now able to receive nearly 9.2 MMcf from Panhandle Eastern Pipe Line Co. but will need a total of 13.9 MMcf for the peak 1953-54 days. The company plans to construct some additional facilities to handle additional gas from Panhandle. Trunkline will establish connection to deliver the ordered 2 MMcf at a cost of $10,000.

In a joint application, Potomac Gas Co., a wholly-owned subsidiary, and Washington Gas Light Co., Washington, D. C., have requested authorization for merger. The action is part of a program for unification of Washington Gas and its subsidiaries. Two others, Prince George's Gas Corp. and Washington Gas Light Co. of Maryland Inc., were liquidated on July 31, 1953, and the merger of Rosslyn Gas Co. in Virginia is expected to be effective soon. Potomac's facilities are located in Virginia also.

Pipeline People

JAMES E. MOODY, industrial engineer for Southwestern Gas & Electric Co., Shreveport, was elected president of the Petroleum Electric Power Assn. at its annual meeting in Kansas City.

Barber-Greene Co., Aurora, Ill. has appointed a new sales manager for its northeastern sales area, composed of all of New England, New York state and part of New Jersey. EDWARD J. CURTIN succeeds EARLE F. LAMPREY in the post. Mr. Lamprey has been assigned to the company's New York office in charge of export activities and government liaison on export matters.

E. J. Curtin **E. F. Lamprey**
Barber-Greene

Panhandle Eastern Pipe Line Co., Kansas City, Mo., has transferred ROY LUNDAY, former superintendent of District 1 of the pipeline division of its gathering department at Stinnett, Texas, to the same job at District "C," Liberal, Kan. E. B. NEWHOUSE, former assistant superintendent at District "D," Hugoton, Kan., has been promoted to superintendent at District "B," Sneed, Okla.

PAUL GRAVES of Spokane was re-elected president and S. I. OLSON of Yakima, Wash. was re-elected a vice president and member of the board of directors of Trans-Northwest Gas Inc. at its recent stockholders' meeting in Spokane. Trans-Northwest's application to transmit gas from Canada throughout the U. S. northwest is still pending before FPC.

Recent advancements in personnel of Union Producing Co., part of the United Gas System, include W. J. QUIGLES and E. L. RAWLINS, elected vice presidents; C. A. MCDOWELL, made general superintendent of production; and T. W. JOHNSON, named general superintendent of production engineering.

Northern Natural Gas Producing Co., subsidiary of Northern Natural Gas Co., Omaha, has announced that personnel from its Bismarck, N. D. office has been transferred to a new Billings, Mont. office with W. E. LUMB as district geologist in charge of exploratory activity in Montana, North

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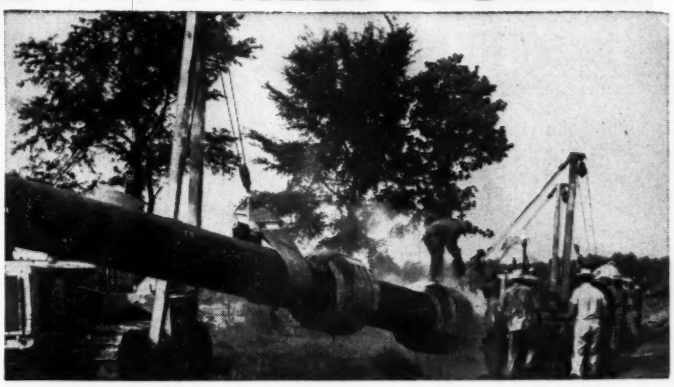

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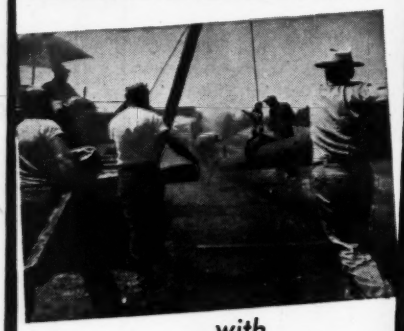
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Dakota, and South Dakota. The Bismarck office has been closed. EARL E. MARSHALL, formerly of the Omaha office, is district geologist for a new Denver office and will be in charge of exploration in Colorado, Wyoming, western Nebraska, and northeastern New Mexico.

A. V. MCMURRAY has been promoted to the position of sales manager of Master Tank & Welding Co., Dallas. He has been in the sales department of the pipe division since 1948.

Texas Eastern Transmission Corp., Shreveport, has announced the appointment of R. CLYDE HARGROVE, partner in Hargrove, Guyton, Van Hook & Hargrove law firm, to the post of assistant general counsel. KEITH M. PYBURN has been appointed attorney in charge of the company's Washington office.

Two sales-engineering representatives have been added to the staff of Tube Turns Inc., Louisville, Ky. BERT GRANT has been assigned to the Pittsburgh office, and CLYDE CHRONISTER to the Tulsa office.

The Darling Valve & Manufacturing Co., Williamsport, Pa. has appointed FRANK B. KREIDER as general sales manager. The past four and a half years he has been eastern regional manager, Insulation Div. for Pabco Products Inc.

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Progress Reports

Wiht this issue GAS is discontinuing the repeat listing of planned construction. Only new projects will be listed henceforth. For a complete listing of planned work still pending approval see the October issue.

CURRENT CONSTRUCTION

GULF INTERSTATE GAS CO., Houston. Docket G-2058 to construct 860 miles of 30-in. line from Rayne, La. to Boyd county, Ky., 229 miles lateral lines and five 8000-hp compressor stations in four states. Mainline contracts let to H. C. Price and Houston Contracting Co. Lateral line contracts let to Anderson Bros., Associated Pipe Line Contractors and Williams Bros. Parkhill Truck Co. hauling pipe. Expect completion Nov. 1, 1954. About 105 miles completed as of Oct. 10.

KANSAS-NEBRASKA NATURAL GAS CO. INC., Hastings, Neb. M & R Construction Co. at work on 26 miles of 12-in. line from Ogallala to Big Springs, Neb.; Brodie Construction Co. at work on 32 miles of 4-in. to 8-in. gathering lines in Hugoton feld, Kan. Contract to be let soon for 18 miles of 6-in. line from Palco to Hill City, Kan.

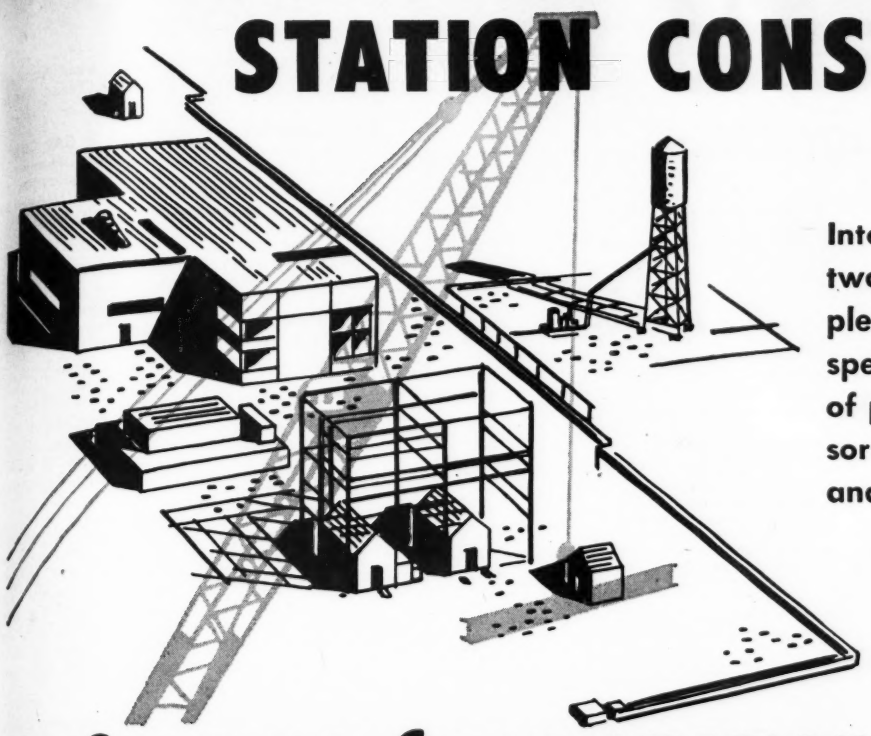
LONE STAR GAS CO., Dallas. At work on 44-mile, 12-in. line from Red Springs field north of Tyler to connection with company line in Hopkins county.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. To construct 10 miles of line from Benezette gas field in Elk county to New Castle, Pa. area. Work begun in September. Williams-Austin Co. at work on 10 miles of 12-in. and 16-in. in Driftwood, and 12 miles of 12-in. in Washington county, Pa.

MISSOURI PUBLIC SERVICE CO., Warrensburg. Mid-States Construction Co. to begin work Nov. 15 on 25 miles of 10-in. line from Warrensburg to Clinton. To be completed Dec. 15.

NEVADA NATURAL GAS PIPE LINE CO., Las Vegas. Docket G-1888 for 110 miles of 10-in. line from Topock, Ariz. to Whitney, Nev., serv-

STATION CONSTRUCTION



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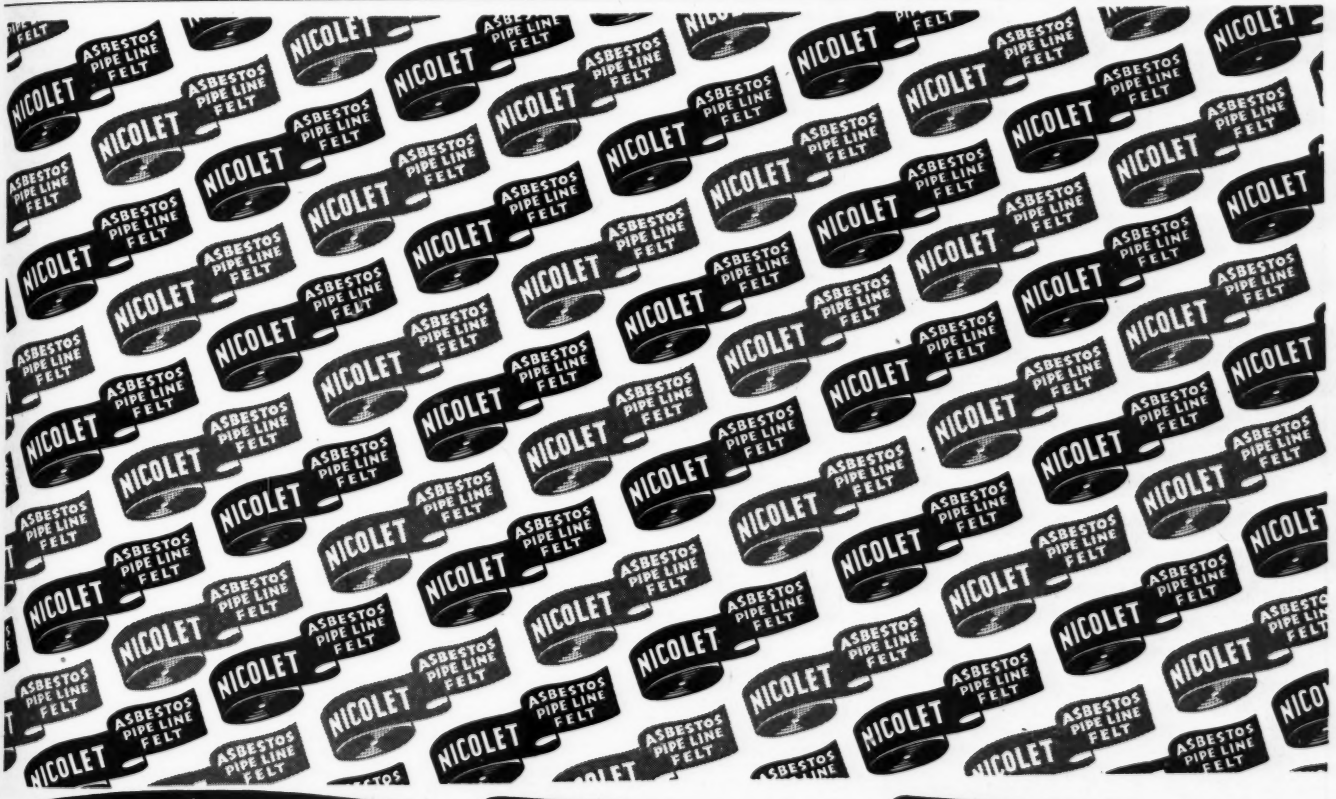

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ing Las Vegas and Henderson areas. Contract let to R. H. Fulton Co., Lubbock, Texas. Gas to flow Dec. 20.

NEW YORK STATE ELECTRIC & GAS CORP., Ithaca. Docket G-1999 for total of 49 miles of pipeline; 25 miles 10-in. from DeRuyther to Norwich, N. Y., 24 miles 8-in. from Norwich to Oneonta, N. Y. Rich & Co. at work. Completion expected Nov. 15.

NORTHERN NATURAL GAS CO., Omaha. Docket G-2063 (in part—first year program) for 259 miles of 24- and 30-in. pipe and 50,400 hp in compressor capacity in new and existing stations in Texas, Oklahoma, Kansas, Nebraska and Iowa. Also 106 miles of branch lines and additions to serve Iowa, Minnesota, Nebraska and South Dakota. G. G. Griffis Inc., R. H. Fulton & Co. and Lone Star Constructors at work on mainline. Compressor work being done by Dresser Engrg. Co., Foor Engrg. Co., H. B. Zachry Co. and Engineers Ltd. Pipeline Co. Completion expected in December.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket G-1892 for 15 miles of 20-in. pipe extending from Helm and joining the system's Topodk-Milpitas line in Fresno county; and for 15.5 miles of 12¾-in. in Madera county parallel to the existing Madera-Livingston line. Alex Robertson Co. completed 5 miles of 20-in. line, 5 miles of 12-in. Remainder to be scheduled for 1954.

PERMIAN BASIN PIPELINE CO., Omaha. Docket G-1928 for 234 miles of line and 54,880 hp in compressor stations to carry gas from Upton, Midland, and Pecos counties, Texas and Lea county, N. M. to connection with 24-in. El Paso Natural line to Dumas, Texas. R. H. Fulton at work on mainline. Fluor Corp. Ltd., Dresser Engrg. Co. and Sterns-Roger Mfg. Co. on compressors. Completion expected in December.

SOUTHERN COUNTIES GAS CO., Los Angeles. Alex Robertson Co. at work on 12-mile, 16-in. line from San Luis Obispo to Arroyo Grande. Expect completion Dec. 10.

SOUTHERN COUNTIES GAS CO., Los Angeles. Docket G-2182 for 14 miles of 24- and 22-in. pipe from connection with Blythe-Santa Fe Springs line near Brea to Santa Ana. Hood Construction at work. Completion expected Nov. 15.

SOUTHERN NATURAL GAS CO., Birmingham. Docket G-1907. Total project approved including 792 miles of line and 18,500-hp compressor capacity—about 522 miles of looping on existing system. About 250 miles various size lines remaining for construction in 1954. All 1953 work to be completed Nov. 15 by Brown & Root Inc., H. C. Price Co., Houston Contracting Co. and Latex Construction Co.

TEXAS ILLINOIS NATURAL GAS PIPELINE CO., Chicago. Docket G-1914 for six new compressor stations totaling 70,000 hp on its Texas to Illinois transmission line and installation of additional units totaling 10,000 hp at five existing stations. Also for construction of a suspension bridge across the Mississippi river and lateral lines to connect additional gas reserves to system. Contracts have been let for compressor work. Completion date, Dec. 1.

APPROVED

CENTRAL KENTUCKY NATURAL GAS CO., Charleston. Docket G-1905 for 8.8 miles of 20-in. lateral extending from connection with Gulf Interstate in Menifee county, Ky. to its own Means, Ky. compressor station.

CITIES SERVICE GAS CO., Oklahoma City. Docket G-2149 for 69 miles of line—44 miles 20-in.; 25 miles 16-in.—and 1100-hp addition to Edmond compressor in Oklahoma county.

PACIFIC GAS & ELECTRIC CO., San Francisco. Docket No. 2212 for 11 miles of 24-in. line to serve steam electric plant near Pittsburg.

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2208 for 17 miles of 6- and 8-in. lines to connect with Englehart and Big Hill gas fields; a 4400-hp compressor station in Shelby county, Texas. Temporary permit granted on 6-in. Englehart line.